HELSINGIN KAUPPAKORKEAKOULU

Kansantaloustieteen laitos

SPILLOVER EFFECTS OF FOREIGN DIRECT INVESTMENT

Kansantaloustieteen
pro gradu -tutkielma
Siina Bly
Syyslukukausi 2001

Kansantaloustieteen laitoksen

laitosneuvoston kokouksessa 14 / 12 2001 hyväksytty

arvosanalla erinomainen (90 p.)

Professori Pertti Haaparanta PhD Kari Hämäläinen

Helsingin kauppakorkeakoulu
Kansantaloustieteen laitos
Pro gradu –tutkielma
Siina Bly

TIIVISTELMÄ

3.12.2001

SUORIEN SIJOITUSTEN EPÄSUORAT VAIKUTUKSET

Tutkielman tavoite

Tutkielman tavoitteena on tutkia monikansallisten yritysten epäsuoria vaikutuksia, niin sanottuja spillover-vaikutuksia (tahattomia teknologiavirtoja) sekä teoriassa että käytännön tasolla.

Tutkimusmenetelmä

Tutkielman teoriaosassa esitellään spillover-käsite ja tutkitaan monikansallisten yritysten vaikutuksia kohdemaan hyvinvoinnille teoreettisten mallien avulla. Lisäksi tutkitaan spillover-vaikutusten olemassaoloa empiiristen tutkimusten avulla. Spillover-vaikutuksia Suomen teollisuuteen analysoidaan käyttäen nelinumerotason toimialatietoja vuosilta 1975-1994. Estimoinneissa käytetään kahta mallia, joiden avulla analysoidaan ulkomaalaisomisteisten toimipaikkojen vaikutusta koko toimialan tuottavuuteen ja saman toimialan kotimaisessa omistuksessa olevien toimipaikkojen tuottavuuteen.

Tutkielman tulokset

Regressioanalyysin mukaan ulkomaalaisomistus vähensi koko toimialan tuottavuutta ja aiheutti merkittäviä negatiivisia ulkoisvaikutuksia saman toimialan kotimaisessa omistuksessa oleville toimipaikoille tarkasteltavan jakson ensimmäisellä puoliskolla. Tulokset eroavat selvästi jakson toisen puoliskon osalta: ulkomaalaisomistus lisäsi koko toimialan tuottavuutta, mutta ulkoisvaikutukset eivät merkittävästi eronneet nollasta. Tarkempi tarkastelu osoittaa, että ulkomaalaisomistuksen negatiivinen vaikutus kotimaisten toimipaikkojen tuottavuuteen ennen säännöstelyn lieventämistä kumoutuu melkein kokonaan viimeisimpien vuosien positiivisten vaikutusten ansiosta.

Avainsanat

Tahattomat teknologiavirrat, suorat sijoitukset, monikansalliset yritykset, tuottavuus

Helsinki School of Economics and Business Administration
Department of Economics
Master's Thesis
Siina Bly

ABSTRACT

3.12.2001

SPILLOVER EFFECTS OF FOREIGN DIRECT INVESTMENT

Research goal

The purpose of this paper is to examine the indirect effects of multinational companies (MNC), spillovers, both in theory and in practice.

Research method

The theoretical part examines spillover effects at a conceptual level and illustrates MNCs' effect on welfare of the host economy by means of formal models. Research papers are examined to see whether empirical evidence supports the existence of spillovers. Spillovers in the Finnish manufacturing sector are analyzed using four-digit industry data, originally gathered at plant level. The period analyzed covers years through 1975 to 1994. The estimations are run for two different model specifications, analyzing the effect of foreign-owned plants on productivity of an industry as a whole and of domestic plants in the same industry.

Results of the study

The estimation results imply that during the first half of the examination period foreign-owned plants decreased the productivity of an industry and generated large and significant negative spillovers for domestically owned plants. The results differ notably for the second half of the period: foreign-owned plants increased the productivity of an industry, whereas spillover effects were insignificantly different from zero. Further examination implies that the negative spillover effect from foreign-owned plants on the productivity of domestic plants before the alleviation of regulations is almost totally offset by positive spillovers during the last years examined.

Keywords

Spillovers, foreign direct investment, multinational companies, productivity

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1 INTRODUCTION

1.1 Foreword

Foreign direct investment (FDI) has been growing rapidly throughout the world during the recent decades. Simultaneously, the world trade has become more and more dominated by multinational companies (MNC). During the latter half of the 1990s the annual growth rate of FDI flows has been around 30 %. The rapidness of the FDI growth can be illustrated by comparison to the growth rate of GDP, which has been at 0,6 %, and of gross fixed capital formation, which has been even negative, at –1,4 %, during the same period. (UNCTAD 2000, 4).

The production of MNCs comprised only about 7 % of world output in 1990, indicating that most of the production is still performed by national companies (Lipsey et al. 1995, 5). However, the share of MNCs in world trade is notably larger: it is estimated that parent companies and foreign affiliates of MNCs accounted for two thirds of world exports of goods and non-factor services in 1993 (UNCTAD 1995, 23). Besides, a sizable portion of international trade is actually intra-firm trade: for example in 1993, parent firms and affiliates of foreign companies located in the United States accounted for 36 % of total U.S. exports and 43 % of total U.S. imports (UNCTAD 1996b, 121).

The effects of FDI have attracted attention both in public media and in economic research. While in the 1960s and 1970s many host governments viewed multinational production welfare decreasing and worried about MNCs' monopoly power which would exploit the economy and stifle local competition, the attitudes in the 1980s became more optimistic. The view that MNCs may have important complementaries with the local industry and can stimulate the host country development increased in significance. As a consequence, many governments of both developed and developing countries have tried to attract FDI by offering tax and financial incentives,

among other policy measures. Such incentives have increased in the 1980s and the transfers involved have been very substantial. For example, as noted by Girma et al. (1999; see UNCTAD 1996a) the British government attracted Samsung to invest in North East England and Siemens in Newcastle by providing the equivalent of USD 30 000 and USD 50 000 per employee, respectively.

The significant scale of these subventions from public funds implies governments' belief that there are benefits from attracting FDI. It has been argued that a key motivation for attracting MNCs is the productivity gap between foreign- and domestically owned firms and the resulting potential for spillovers. These indirect effects of FDI, which arise from the realization of external economies, may justify FDI promotion in case the net welfare effect of FDI is positive and the social return to FDI exceeds its private return (Hanson 2001, 15).

The empirical studies on spillovers from FDI have reached contradicting conclusions. While most of the early studies evidenced positive spillover effects, specifically in developed countries, some more recent studies in developing countries have found MNCs' impacts to be insignificant or even negative.

Although Finnish companies have been active in investing abroad, the Finnish inward FDI has remained very modest until the 1980s. Since then, FDI inflows have started to increase significantly, and the share of net sales and employees of foreign-owned companies have increased to 14 % and 10 % respectively by 1998. The share of foreign-owned companies is even more significant in larger companies. Although there are studies investigating characteristics of foreign-owned companies in Finland, the research lacks evidence of the effects of MNCs on the rest of the economy. On the other hand, there can be seen a tendency to improve the attractiveness of Finland as a location for competitive foreign-owned firms (see for example Ali-Yrkkö 1997, 26).

1.2 Objectives and limitations

The purpose of this paper is to examine the spillover concept both in theory and in practice. The theoretical part presents spillover effects at a conceptual level, after which a few formal models are described in order to investigate MNCs' effect on welfare of the host economy. Then, research papers are examined to see whether empirical evidence supports the existence of spillovers.

At least to the knowledge of the author, there is no empirical evidence of spillovers from MNCs in the Finnish economy. Taking into consideration the vast increase in the Finnish inward FDI since the 1980s, the question of FDI promotion has become more relevant also here. There is already evidence of subsidies to foreign-owned firms operating in Finland (Malin 1998, 30). In case there are significant positive spillovers from operations of MNCs in Finland, it could make economic sense to induce MNCs to Finland by policy measures. In the opposite case, that is, with insignificant or negative spillover effects, FDI promotion would not increase economy's welfare.

Therefore, this paper adds to the empirical research by providing evidence on the effect of foreign-owned companies on productivity of domestic firms in Finland. The analysis is performed using four-digit industry data, originally gathered at plant level by Statistics Finland. The period analyzed covers years through 1975 to 1994.

Throughout this paper, only *inward* FDI is discussed, since spillovers are mainly associated with inward FDI[1]. The welfare considerations are from the host economy's point of view, although there may be spillovers to the source economy as well (see Blomström and Kokko 1998). When the theoretical approaches are presented attention is paid to factors giving rise to external economies, that is, spillovers, and to

[1] The model by Siotis (1999), discussed briefly in section 4.4, takes into account the possibility that host country firms can be a source of positive externalities for MNCs, thus giving motivation for outward FDI.

welfare effects in the host economy. Hence, international trade theory and different models explaining how MNCs arise are left with less focus.

1.3 Structure of the paper

To begin with, this paper provides a brief overview of the theories of multinational production (chapter 2). Emphasis is given to industrial organization approach, which represents a microeconomic view. The model by Markusen and Venables (1995), described in section 2.3, defines knowledge capital as an important reason for multinational production, and is presented because this type of capital is the most likely source for spillovers.

Chapter 3 describes both direct and indirect impacts of FDI on host economies. Emphasis is given to indirect effects, spillovers. The chapter discusses various types of spillovers, as well as the determinants of their scope and magnitude. Chapter 4 provides more detailed theoretical approaches that explicitly consider spillovers and the effects of MNCs on the host country welfare. The models discussed in further detail assume firm perspective and consider the behavior of MNCs and domestic firms in a situation where MNCs have already established in the host economy. Besides concluding the chapter, section 4.4 introduces alternative viewpoints. Chapter 5 describes empirical research on existence of spillovers.

From chapter 6 onwards the viewpoint is from the Finnish economy. Chapter 6 provides the background for the Finnish inward FDI, presents the recent trends and discusses the characteristics of foreign-owned firms operating in Finland. Chapter 7 presents the data and model specifications for the empirical study as well as analyzes the estimation results. The final chapter summarizes and concludes the paper.

1.4 Essential concepts

Foreign direct investment (FDI) is broadly defined as spending of domestic firms for establishing foreign operating units (Husted & Melvin 1998, 423). The distinction between portfolio investment and FDI lies in that FDI involves not only transfer of capital but also other resources such as technology, management, and organizational and marketing skills. Furthermore, FDI retains control over the resources transferred. (Dunning 1981, 76) United Nations' definition of FDI emphasizes the long-term nature of the relationship and a lasting interest and control of the investor. *FDI inflows (outflows)* are defined as capital provided by a foreign direct investor to a FDI enterprise (capital received from a FDI enterprise by a foreign direct investor) in the form of equity capital, reinvested earnings or intra-company loans. *FDI stock* in turn is comprised of the value of the share of affiliates' capital and reserves attributable to the parent company and the net indebtedness of affiliates to the parent company. (UNCTAD 1996b, 219-220)

FDI corresponds to arise of *multinational companies* (MNC), defined as corporations that own and operate capital in more than one country (Husted & Melvin 1998, 304). A *vertically integrated MNC*, consisting of headquarters (upstream facility) and downstream production plants, divides the production process geographically, by stages of production. A typical example of a vertically integrated MNC can be found within auto manufacturing: components are produced in one location and then delivered as subassemblies for the final assembly in another location. A *horizontally integrated MNC* duplicates the entire production process, except for the headquarter activities, in different countries, thus producing roughly similar final products in its different locations. (Markusen 1995, 170) Examples of horizontally integrated MNCs include bakeries and breweries (Caves 1982, 2). Horizontal FDI is more important quantitatively, and relates closely to recent models of international trade (Markusen 1995, 170).

MNCs tend to have a high ratio of intangible assets to total market value. That is, MNC intensive industries are characterized by R&D, marketing expenditures, high-skilled workers and new, complex and differentiated products. (Markusen 1995, 174) Furthermore, MNCs are often found to be larger and more profitable, pay their workers higher wages, have higher factor productivity and be more likely to export than their domestic counterparts[2].

Spillovers are indirect effects resulting from the presence of MNCs, arising from the realization of external economies. Since technology to some extent is a public good, host country firms can gain from the superior technology and skills of MNCs. *Productivity spillovers* are said to take place when MNCs' presence leads to productivity or efficiency gains in the host country's local firms. *Market access spillovers* result from linkages with MNCs, which help local firms to establish exporting activities of their own.

2 MOTIVES FOR MULTINATIONAL PRODUCTION

The theory of foreign direct investment and existence of multinational companies is shortly presented to facilitate understanding of the impacts of FDI. As Parry (1980, 5) puts it, the impacts of MNCs' operations on the host economy can be linked to the underlying explanations of FDI. Conceptual models of FDI and international trade have traditionally been developed separately: trade theory (section 2.1) emphasizes why countries trade with each other, while FDI theory (section 2.2) aims at explaining why individual firms invest in particular countries. The 'new trade theory', presented in section 2.3, contributes to the comprehension of trade patterns by incorporating industrial organization concepts in the traditional trade theory framework. This section describes in further detail the model by Markusen and

[2] See Hanson (2001) for related studies.

Venables (1995), which illustrates welfare effects of MNCs in a traditional framework without considering possible spillover effects.

2.1 Basic theories of international trade

The traditional theory of international trade is based on the concept of *comparative advantage*[3]. A country is said to have a comparative advantage in a good if that good has a lower pre-trade relative price than can be found elsewhere in the world. Each country specializes in the production of its comparative advantage good (or goods) and exports the excess of that good in exchange for the other. Specialization of countries leads to greater world output and welfare. International trade occurs along the lines of comparative advantage, because comparative advantage good of each country sells initially at a lower price than in other countries. The world price in equilibrium is established by the forces of international supply and demand. (Husted & Melvin 1998, 66-73)

In the early decades of the twentieth century the international trade theory was further developed by Heckscher and Ohlin, who explained international trade as a consequence of differences in relative factor endowments. They argued that a country has a comparative advantage in a good, the production of which requires relatively large amounts of factors with which that country is relatively well endowed. Free international trade leads to equalization of factor payments: since international trade increases the demand for the product which uses the abundant factor of production of that country, the return to that factor rises whereas return to the scarce factor falls. In other words, for labor abundant countries with initially low wages there is a tendency of wages to increase as a consequence of the increased demand for labor. The opposite is true for rental rates on capital. Thus, the factor price equalization theorem implies that the international trade benefits the abundant factor and harms the scarce

factor of each country. However, the benefits at the economy level outweigh the losses so that international trade still benefits both countries. (Husted & Melvin 1998, 92-114)

The basic international trade theories described above exclude the presence of multinational firms. In addition, the models are based on restrictive assumptions, notably they assume constant returns to scale and perfect competition. Essentially the contradicting observations in world trade flows - the large volume of trade in similar products between countries with similar endowments - motivated for extending Heckscher-Ohlin model (HO-model) by adding elements from industrial organization approach: increasing returns to scale, imperfect competition and product differentiation. Moreover, the growth of FDI stocks relative to trade flows induced economists to model multinational production. (Markusen & Venables 1996, 1-2)

2.2 Industrial organization approach

While HO-models emphasize macroeconomic point of view, microeconomic explanations and the significance of *firm-specific assets* have gained increasing emphasis in more recent studies. The industrial organization approach explains FDI from a firm point of view: firms exploit economies of scale and product differentiation in an imperfectly competitive environment. Real-world observations support this view: multinationals are often found in industries characterized by high barriers to entry, such as need for large capital outlays, scale economies in production and dominant role of advertising and R&D. In other words, MNCs are important in industries where intangible, firm-specific assets are important. These assets are usually knowledge-based: product or process know-how, reputation or trademarks. (Markusen 1995, 169)

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[3] The models usually assume two countries, both of which produce initially two types of goods. The production of one type is relatively more labor intensive whereas the production of the other is more

MNCs are assumed to differ from national firms, as otherwise they would not find it profitable to enter foreign markets. When operating in a foreign country, a multinational firm faces costs of foreignness: communication and transport costs, as well as barriers due to languages, customs and being outside the local business and government networks. In his widely quoted dissertation in 1960, Hymer argued that a MNC must possess a special advantage, such as superior technology or lower costs arising from scale economies. Hymer's argument precedes the spillover concept as it implies a gain to the host country as MNC brings inherent advantages to it, such as technological know-how. Moreover, Hymer acknowledges also offsetting costs such as increased monopoly power resulting in the transfer of rents away from host country firms. (Markusen 1995, 173)

Hymer's dissertation shifted the focus from the theory of international capital flows to analyzing FDI as a firm-driven managerial decision (Rugman 1999, 58). Parry (1980, 27-28) describes one of the earliest theories, namely *product life cycle theory* originated by Vernon in 1966. According to the theory, the location of innovations is correlated with market characteristics: innovations that firms undertake are closely related to the potential demand of the market where the firms operate. Thus, firms in developed, high-wage countries tend to design labor-saving processes and products for high-income consumers. In the development phase of the product's life cycle production is unstandardized and relatively skilled-labor intensive. Output is directed to the home market. During the growth phase, demand expands rapidly as the home market accepts the product in wider use, and the production moves towards larger scale and longer production runs. Foreign demand is met by exports until the mature phase of the product's life cycle. As the product matures it becomes standardized and production is transferred to foreign markets, preferably to a country with least factor costs. The timing of foreign investment depends on various circumstances, such as trade barriers and responses of foreign competitors.

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capital or, alternatively, skilled-labor intensive.

A widely used framework for analyzing the existence of MNCs was developed by Dunning (1981). He suggests that three conditions are required for a firm to undertake direct investment: ownership, location and internalization advantages (OLI-framework). The *ownership* advantage can be a product or production process not accessible to other firms, or an intangible asset such as a trademark or reputation. The ownership advantage provides MNC with valuable cost advantage or market power that outweighs the disadvantage of doing business abroad. Moreover, the foreign market should offer *location* advantage inducing the firm to produce abroad instead of serving the foreign market by exports. Location advantages include avoidance of trade barriers such as tariffs, quotas and transport costs, cheap factor prices and access to customers. Finally, the *internalization* advantage refers to exploiting ownership advantage internally within the firm rather than through markets, for example through a license agreement. The benefits from internalizing the transfer of assets are determined by various factors such as form of corporate governance, costs of internal transfer relative to those of arm's length transactions, specific characteristics of the knowledge and market failures. (Markusen 1995, 173-174)

Dunning's OLI-framework can be seen as a basis for the so-called *knowledge-capital* model. The ownership advantage arises from knowledge-based, firm-specific assets possessed by MNCs. This approach is supported by the real-world observation that MNCs tend to have a high ratio of intangible assets to total market value. There are two reasons for the importance of knowledge-based assets: first, they are easy to transfer at low cost, at least compared to physical assets, and second, knowledge has a joint character which gives rise to economies of multiplant production. Knowledge-based assets, such as blueprints or trademarks, can yield services in many locations without reducing their productivity in others. Hence, MNCs can be modeled as exporting firm-specific assets, like management, marketing, engineering and financial services, in exchange for repatriated profits, royalties and fees. (Markusen 1995, 174-175)

2.3 Integrated models

The recent models of multinational production are based on the concept of *economies of multiplant operation*: to produce a good a firm must incur firm-level fixed costs, such as R&D, advertising or investment in management structure, which can support production in many plants. A MNC consists of headquarters (upstream facility) and downstream production plants. Headquarters activities are supposed to be relatively skilled labor or capital intensive while production is relatively unskilled-labor intensive. Supposing that factor prices are not equal across countries, a firm has an incentive to become a multinational to exploit these differences. A firm can benefit from locating its headquarters in a capital-abundant country, where capital costs are low, and its production facilities in a labor-abundant, low-wage country. This gives rise to *vertical* FDI. Vertically integrated MNCs are modeled in general equilibrium trade framework by Helpman and Krugman (1985).

Whereas Helpman and Krugman assume differences in factor prices, Markusen and Venables (1995) develop a model, the key elements of which include firm-level activities like R&D, marketing or management that are joint inputs across plants, plant-level scale economies and tariffs or transport costs between countries. This approach allows for factor price equalization. When transport costs, tariffs or firm-level fixed costs are sufficiently high relative to plant-level scale economies, a firm has an incentive to serve foreign markets from a foreign plant instead of exporting goods from home country. This gives rise to *horizontal* FDI.

Knowledge capital, the source of ownership advantage and the basis for the firm-level scale economies, is also important as a source for spillovers. As noted before, knowledge has a joint character which gives rise not only to economies of multiplant production in proprietary company but also to spillover effects in the host country firms. Therefore, the rest of the chapter examines the model of Markusen and

Venables (1995) in further detail[4]. The model presented here illustrates the impact of FDI in a traditional framework without spillovers, which are included in the models examined in chapter 4.

In the constructed model MNCs arise endogenously as a response to high transport and tariff costs, high incomes of countries and high firm-level scale economies relative to plant-level scale economies. The model solves for the equilibrium 'regime' as a function of technology and country characteristics. The regime is defined by types of firms active in equilibrium. The general result of the paper is that multinationals are more likely to exist the more similar countries are in size, factor endowments and technical efficiency. This result is referred to as *convergence hypothesis*. Intuitively, when countries differ in these characteristics, single-plant firms derive advantage from concentrating their production in the country with larger sales, lower factor costs and/or higher factor productivity. Having to locate additional capacity in the small or costly market means a disadvantage to MNCs when the countries are quite different. Finally, Markusen and Venables consider the welfare consequences of MNCs.

The model assumes two countries, home h and foreign f, which produce two homogenous goods, X and Y. There are two factors of production, L (labor) and R (resources): L is mobile between industries but internationally immobile while R is a specific factor used only in the Y sector. Y is used as numeraire throughout the model. Expansion of the X sector draws labor from the Y sector, raising the R/L ratio as well as the cost of labor measured in terms of Y. Labor is used for both fixed and variable costs in producing X and moreover, there are transport costs between the countries, specified as units of labor per units of X exported.

[4] Respectively, the rest of the chapter is based on Markusen and Venables (1995).

The countries (h, f) are distinguished by subscripts (i, j). (n_i, m_i) indicate the number of active multinational, m, and national firms, n, based in country i. The output of Y in country i is determined by Cobb-Douglas function,

$$(1) \qquad Y_i = \theta_i L_{iy}^{\alpha} R_{iy}^{1-\alpha}, \qquad i = h, f,$$

where R_i is country i's endowment of R and θ_i is the country specific efficiency parameter. By setting the wage rate, w_i, equal to the marginal product of labor, the labor demand in the Y sector can be determined by:

$$(2) \qquad w_i = \alpha\theta_i (L_{iy} / R_i)^{1-\alpha}, \qquad i = h, f.$$

Since a national firm undertakes all its production in its home country, the labor required by a national firm in country i can be written as

$$(3) \qquad c_i X_{ii}^n + (c_i + \tau) X_{ij}^n + G_i + F_i, \qquad i = h, f, \ i \neq j,$$

where X_{ij}^n is the sales in country j of a national firm based in country i, c_i is the constant marginal production cost and G_i and F_i are the plant-specific and firm-specific fixed costs. τ measures the amount of labor required to transport one unit of X from one country to another.

A multinational firm based in country i operates one plant in each country but incurs its firm-specific cost only in its home country i. Sales of a multinational are assumed to be met entirely from local production, so the demand for country i labor by a multinational based in country i can be determined by

$$(4) \qquad c_i X_{ii}^m + G_i + F_i, \qquad i = h, f,$$

and the demand for country j (host country) labor by

$$c_i X_{ij}^m + G_i \ , \qquad i = h, f. \tag{5}$$

Initially, the technology used by the MNC is assumed to be determined by the location of its plants, not of its headquarters.

The total labor endowment of country i is denoted by $\overline{L}_i$. The factor market clearing condition is determined by adding together labor demand from n_i national firms, m_i multinational firms based in country i and m_j multinationals based in country j:

$$\begin{aligned} \overline{L}_i &= L_{iy} + n_i(c_i X_{ii}^n + (c_i + \tau)X_{ij}^n + G_i + F_i) + m_i(c_i X_{ii}^m + G_i + F_i) \\ &\quad + m_j(c_i X_{ji}^m + G_i). \end{aligned} \tag{6}$$

In equilibrium, the X sector makes zero profits. Thereby, country i income, denoted as M_i, is given by

$$M_i = w_i L_i + (1-\alpha)Y_i, \qquad i = h, f. \tag{7}$$

The price of X in country i is denoted by p_i, and the consumption of X and Y are denoted as X_{ic} and Y_{ic}. By applying Cobb-Douglas utility function of the representative consumer in each country, $U_i = X_{ic}^{\beta} Y_{ic}^{1-\beta}$, $X_{ic} \equiv n_i X_{ii}^n + n_j X_{ji}^n + m_i X_{ii}^m + m_j X_{ji}^m$, the demand functions can be written as

$$X_{ic} = \beta M_i / p_i, \qquad Y_{ic} = (1-\beta)M_i. \tag{8}$$

Equilibrium in the X sector is determined by pricing equations, that is, equating marginal revenue to marginal cost, and free-entry conditions. Pricing equations of national and multinational firms can be written as (with associated variables in brackets)

$$p_i(1-e_{ii}^n) \le w_i c_i \qquad (X_{ii}^n), \tag{9}$$

$$p_j(1-e_{ij}^n) \le w_i(c_i+\tau) \qquad (X_{ij}^n), \tag{10}$$

$$p_i(1-e_{ii}^m) \le w_i c_i \qquad (X_{ii}^m), \tag{11}$$

$$p_j(1-e_{ij}^m) \le w_j c_j \qquad (X_{ij}^m), \tag{12}$$

where e_{ij}^k, $k=n,m$, denotes proportional markups of price over marginal cost. In a Cournot model with homogenous goods, the optimal markup formula is given by the firm's market share divided by the Marshallian price elasticity of demand in that market. As can be seen from equation (8), the price elasticity equals one. Therefore, using demand equations (8) yields

$$e_{ij}^k = \frac{X_{ij}^k}{X_{jc}} = \frac{p_j X_{ij}^k}{\beta M_j}, \qquad k=n,m, \qquad i,j=h,f. \tag{13}$$

The output in terms of price can be determined by using this expression in pricing equations:

$$X_{ii}^n \ge \beta M_i \frac{p_i - w_i c_i}{p_i^2} \tag{14}$$

$$X_{ij}^n \ge \beta M_j \frac{p_j - w_i(c_i+\tau)}{p_j^2} \tag{15}$$

$$X_{ii}^m \ge \beta M_i \frac{p_i - w_i c_i}{p_i^2} \tag{16}$$

(17) $$X_{ij}^{m} \geq \beta M_j \frac{p_j - w_j c_j}{p_j^2}$$

Each of these equations hold with equality if the right-hand side is positive, otherwise output is zero. Given equations (9)-(12), zero-profit conditions can be constructed by requiring that markup revenues equal fixed costs:

(18) $$p_i e_{ii}^{n} X_{ii}^{n} + p_j e_{ij}^{n} X_{ij}^{n} \leq w_i (G_i + F_i) \qquad (n_i),$$

(19) $$p_i e_{ii}^{m} X_{ii}^{m} + p_j e_{ij}^{m} X_{ij}^{m} \leq w_i (G_i + F_i) + w_j G_j \qquad (m_j).$$

If outputs are positive, these free entry conditions can be written as (using equations (14)-(17))

(20) $$\beta \left[M_i \left(\frac{p_i - w_i c_i}{p_i} \right)^2 + M_j \left(\frac{p_j - w_i (c_i + \tau)}{p_j} \right)^2 \right] \leq w_i (G_i + F_i) \qquad (n_i),$$

(21) $$\beta \left[M_i \left(\frac{p_i - w_i c_i}{p_i} \right)^2 + M_j \left(\frac{p_j - w_j c_j}{p_j} \right)^2 \right] \leq w_i (G_i + F_i) + w_j G_j \qquad (m_i).$$

While the equations (14)-(17) are associated with output levels, the equations above, (20)-(21), are associated with the number of firms of each type. The general equilibrium of the model can be solved only numerically due to the technical complexity, so the partial equilibrium analysis is used instead. Supposing that the Y sector uses only labor as a factor of production and has constant returns to scale (that is, α=1 in equation (1)), wages and income levels are determined by parameter and endowment values:

(22) $$w_h = \theta_h, \quad w_f = \theta_f, \quad M_h = w_h \overline{L}_h, \quad M_f = w_f \overline{L}_f.$$

The analysis is simplified by not distinguishing type-m firms by their home country. Thus, there is only one type of multinationals, which divides its firm-specific fixed cost equally between the two countries. With these assumptions there are three zero profit conditions containing only two endogenous variables, p_h and p_f. The analysis begins with assuming that the economies are symmetric and only type-m firms are active. Then, equating supply and demand for good X in each country yields

$$(23) \qquad mX_h^m = \beta M_h / p_h, \qquad mX_f^m = \beta M_f / p_f .$$

Eliminating m and using the supply equations (16) and (17) yields

$$(24) \qquad p_h /(w_h c_h) = p_f /(w_f c_f) .$$

Analogously, when only type-n_h or type-n_f firms are active the respective results can be written as

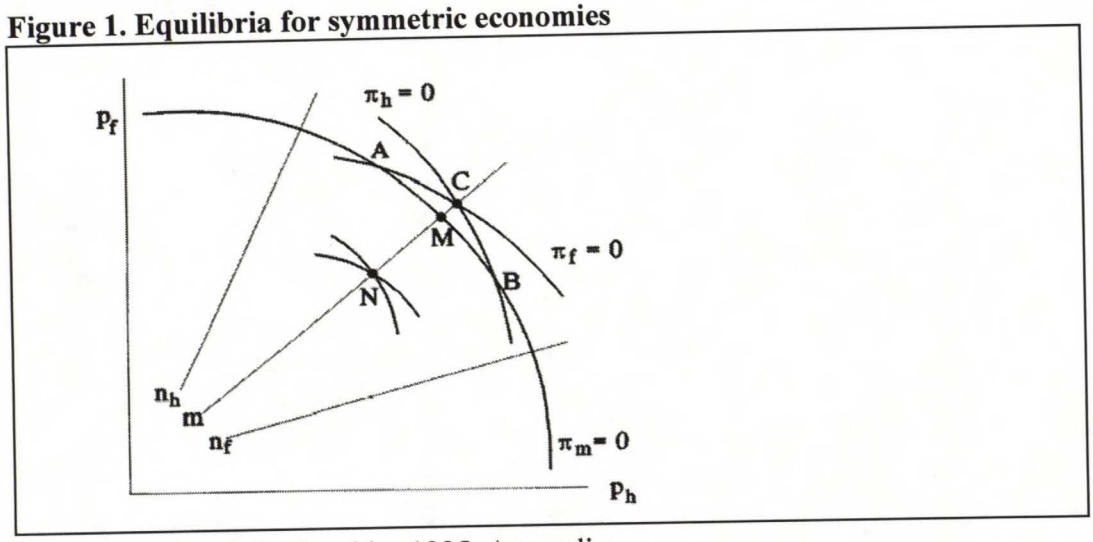
$$(25) \qquad p_h / c_h = p_f /(c_f + \tau) ,$$

$$(26) \qquad p_f / c_f = p_h /(c_f + \tau) .$$

The case of symmetric economies is illustrated in Figure 1. The relationships in equations (24)-(26) are represented by the three straight lines m, n_h, n_f. The zero profit conditions are illustrated as the three curves: for example, the curve $\pi_m = 0$ is the zero profit locus for type-m firms, above which the profits are positive and below negative. Figure 1 shows that two kinds of equilibria are possible: if the zero-profit loci for national firms intersect above the curve $\pi_m = 0$, the equilibrium is at M, where only type-m firms are active. The other type of equilibrium is achieved if the intersection of zero-profit loci for national firms lies below the point M, illustrated as

point N in Figure 1. At point N, there is equal number of national firms in each symmetric country, supplying both their home and exports market.

Figure 1. Equilibria for symmetric economies



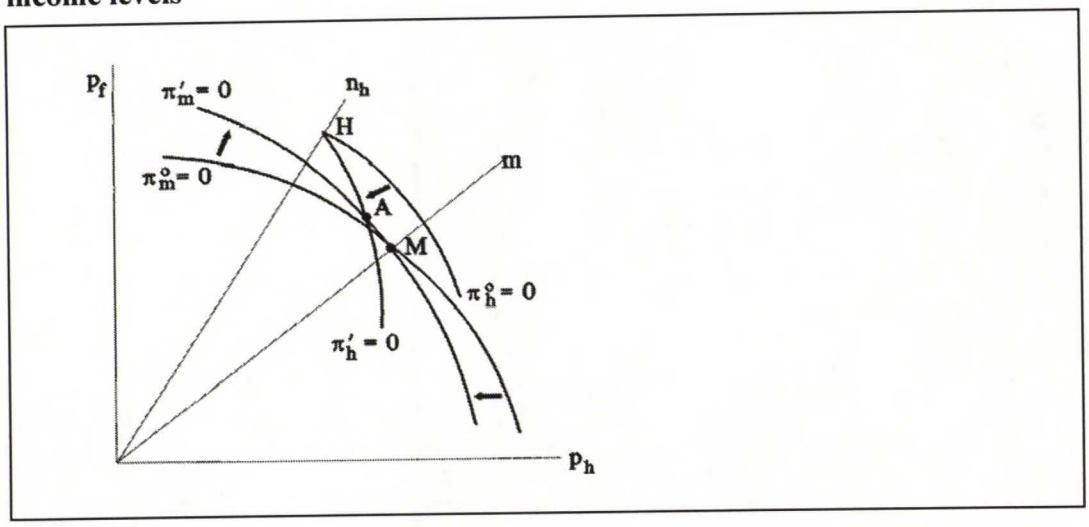
Source: Markusen & Venables 1995, Appendix

In sum, the theory predicts that MNCs and national firms do not coexist except with parameter values such that all three zero profit loci intersect at the same point. Thus, there are two types of technologies, of which one dominates the other: one with high fixed costs and low variable costs (type-m firms) and another with low fixed costs and high variable costs (types n_h and n_f). The cases are determined by magnitudes of transport costs, plant- and firm-level economies of scale and market size. The existence of MNCs becomes more likely if transport costs increase (indicated by an outward shift of the zero profit loci for national firms), incomes rise (making it more likely that high fixed cost technology dominates the high variable cost option of exporting) or the proportion of firm-level scale economies grows relative to plant-level scale economies.

The partial equilibrium analysis continues with examination of how asymmetries between economies affect the equilibrium regime. Beginning with initial equilibrium at point M in Figure 1, some amount of income is transferred from country f to h

(meaning that in equations (20)-(21) $\Delta M_h = -\Delta M_f > 0$.) If all firms are type-m, they are indifferent to the distribution of income because the set of prices where $\pi_m = 0$ does not change along the m-locus ($p_h = p_f$). However, at the relative prices given by the slope of n_h locus the transfer of income from *f* to *h* reduces profits for type-m firms as $p_h < p_f$. In other words, the transfer of income rotates the $\pi_m = 0$ locus around the point *M* as illustrated in Figure 2. Similarly, the type-h firms are indifferent to the transfer of income in case all firms are type-h, but at the relative prices along the m-locus ($p_h = p_f$) the income transfer increases the profits of type-h firms. Thereby the $\pi_h = 0$ locus rotates around the point *H* in Figure 2.

Figure 2. Effects for equilibrium regime as a result of a change in relative income levels



Source: Markusen & Venables 1995, Appendix

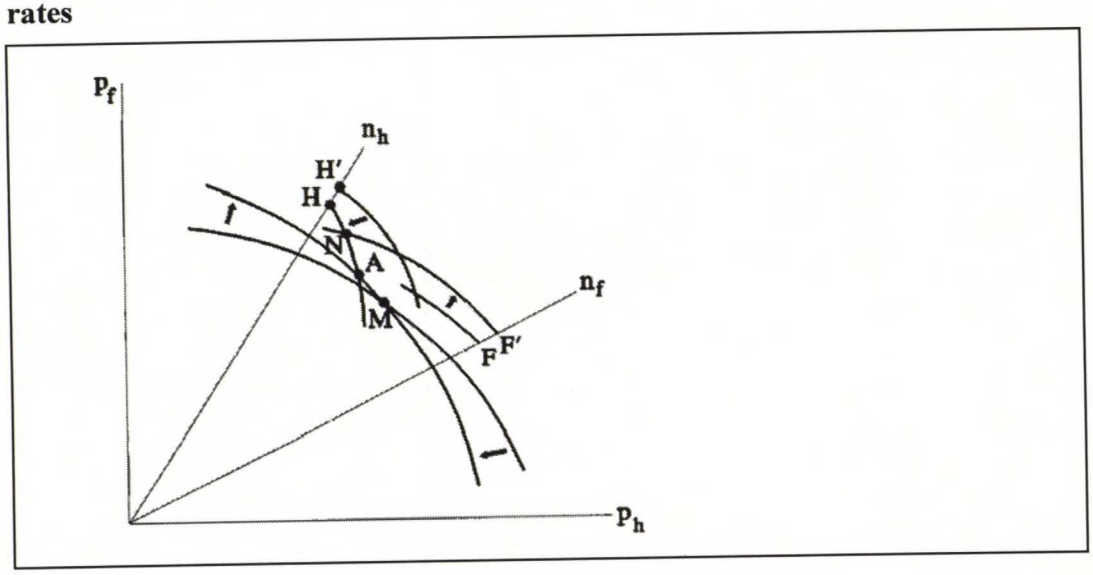
A sufficient change in incomes of the countries shifts the equilibrium regime. As illustrated in Figure 2, the equilibrium shifts from point *M*, with only m-type firms, to a regime characterized by both m- and h-type firms, such as point *A*. As the difference in income levels increases, the equilibrium is found at point *H* where only type-h firms exist. Intuitively, MNCs would experience a disadvantage compared to

single-plant firms, as they would have to locate additional capacity in the smaller market, that is, in country *f* with smaller income and therefore smaller sales. In conclusion, MNCs become more dominant and start to displace international trade as countries converge in size.

Countries can also differ in terms of technologies and relative factor endowments. From equations (20)-(21) it can be seen that changing a country's *R/L* endowment ratio, reflected as an increase in its wage rate, equals an increase in all of the cost coefficients, that is, c, τ, F and G. Thus, the impact of a change in factor endowments is similar to a change in technology.

Therefore, the analysis continues with considering a small raise in w_f and an identical decline in w_h ($\Delta w_f = -\Delta w_h > 0$), beginning again from the case with symmetric economies, holding income levels constant. Similarly to the analysis of income transfer, MNCs are indifferent to wage changes when only type-m firms exist, but along the n_h locus the changes reduce MNC profits, leading to rotation of the $\pi_m = 0$ locus around the point M (see Figure 3). Unlike in the income transfer analysis, the $\pi_h = 0$ locus shifts inwards as a result of the change in relative wage rates at all output prices, since type-h firms demand only home country labor. Analogously, the $\pi_f = 0$ locus shifts outwards. The results of a change in relative wage rates are similar to the preceding analysis: the equilibrium shifts from point M with symmetric economies and only type-m firms active to the co-existence of both type-m and –h firms (point A in Figure 3) and eventually to an equilibrium with only type-h firms (point N in Figure 3). In sum, MNCs become more likely the more similar the countries are in relative endowments and technologies. Intuitive interpretation is that having to locate additional capacity in the costly market (country *f*) means a disadvantage to MNCs.

Figure 3. Effects for equilibrium regime as a result of a change in relative wage rates



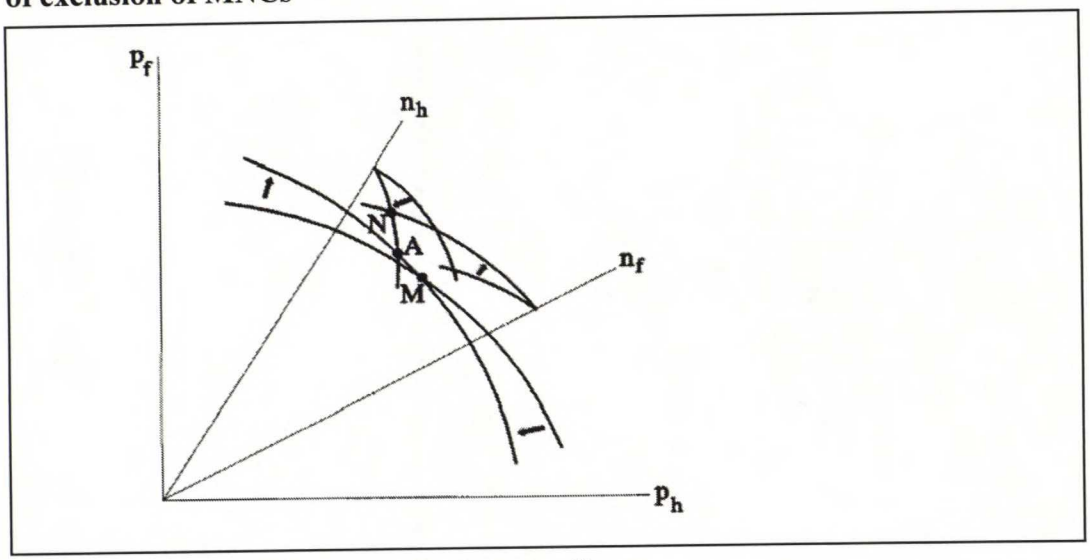
Source: Markusen & Venables 1995, Appendix

Finally, Markusen and Venables (1995) consider the effects of MNCs on a country's welfare, which depends in the partial-equilibrium setting only on p_i, the relative price of X in terms of Y. Taking the income of country i fixed and the zero profit requirement, the budget line of a representative consumer is fixed in terms of Y. The welfare effects of MNCs are compared to a situation where MNCs are exogenously excluded.

Considering symmetric economies and assuming that the zero-profit loci for national firms intercept at point C of Figure 1, the exclusion of MNCs would result in equilibrium at C rather than at M. This means higher prices in both countries and thus, a loss of welfare. With asymmetric countries, the results can be more complex. Figure 4 illustrates the transfer of income from country f to h, which results in a shift of the intercept of the $\pi_h = 0$ and $\pi_f = 0$ curves from the m-locus to the point N. In the case drawn in Figure 4, the equilibrium is achieved at A, with both m- and h-type firms active. The exclusion of MNCs would shift the equilibrium to the point N,

meaning a fall in p_h and a rise in p_f. In other words, as a result of the introduction of MNCs welfare in country *h*, the relatively more advantageous country, falls whereas the welfare in the disadvantaged country *f* rises. Similar results are obtained when analyzing countries which differ in relative endowments or technology. If the transport costs are increased or countries are made more similar, point *N* moves to the Northeast and the equilibrium is achieved at point *M*, meaning that both countries benefit from the presence of MNCs. To summarize, the host country seems to always gain from the presence of MNCs whereas the home country may either gain or lose.

Figure 4. Transfer of income from country *f* to country *h* and the welfare effects of exclusion of MNCs



Source: Markusen & Venables 1995, Appendix

The model by Markusen and Venables (1995) presented above serves as a basis for the examination of impacts of MNCs on the host country. The model considers traditional effects of FDI on the host country welfare while it excludes the presence of spillovers from MNCs' operations. These effects are presented first at a conceptual level in the following chapter, and the impact of MNCs on the host country welfare is modeled taking into account the presence of spillovers in chapter 4.

3 EFFECTS OF FDI – A CONCEPTUAL DISCUSSION

The partial equilibrium analysis presented in the previous chapter considered MNCs' contribution to countries' welfare through price changes, assuming wages and income to be determined by parameter and endowment values. This chapter adds to the analysis by considering other impacts of MNCs on the country they operate in. The discussion of this chapter is given at a conceptual level; the welfare effects of MNCs and spillovers are modeled explicitly in chapter 4.

The traditional trade theory has emphasized the direct effects of FDI on factor rewards, employment and balance of payments, while the industrial organization approach has put more emphasis on indirect effects, spillovers. Direct effects from FDI are described briefly in the following section and the rest of the chapter is dedicated to indirect effects: intra-industry productivity spillovers are described in section 3.2.1, whereas section 3.2.2 discusses inter-industry spillovers. The final section examines determinants of spillovers.

3.1 Direct effects of FDI

Foreign direct investment involves transfer of capital, as well as other resources, from home to host country. Thus the logical point to start evaluating effects of FDI is the balance of payments. Initially, the capital injection improves the balance of payments for the host country, and if the investment is export-oriented or import-substituting, it contributes to further improvements. Improving balance of payments may be of high importance to a developing host economy, which has shortage of foreign exchange required to pay for imports of investment goods. On the other hand, FDI affects continuously balance of payments, as the subsidiary repatriates profits and other payments, such as royalties, thus offsetting the effects of local borrowing and reinvestment of profits. MNCs may also increase imports by purchasing inputs from abroad. (Caves 1982, 272-274)

FDI influences the returns to factors of production: importing capital to the host country lowers the rate of return to capital, while real wages tend to increase due to the increased demand for labor. On the other hand, MNCs' demand for labor may be more elastic due to alternative production sites causing more resistance to unions' wage demands. MNCs may also resist wage increases by arbitraging innovations in labor relations, although MNCs' foreignness is a disadvantage in wage negotiations. (Caves 1982, 158-159) Moreover, a fall in the rate of return to capital can depress the domestic saving, and as a consequence, decrease the growth rate of host national income. (ibid., 272-274)

According to the analysis by McDougall in 1960 the host country's benefit from FDI is mainly derived from the prevailing tax arrangement where the host country gets the first crack of the profits generated by MNCs. In his analysis, (in a world of competitive industries and no externalities) FDI benefits the host economy through an increase in national income of labor and tax revenue. (Caves 1982, 230-231) When considering collectible taxes from MNCs it should be taken into account that MNCs can influence their taxable profits through transfer pricing so as to move profits into jurisdictions with the lowest tax rates. Transfer pricing must withstand government scrutiny, but royalties and other intangibles transactions still offer a lot of opportunities for manipulation of profits. (ibid., 251)

Caves (1982, 274-275) also discusses the connection between FDI and the growth rate of national income. An inflow of capital increases the growth rate as it influences gross domestic investment. A positive effect may also be due to provision of progress to the less developed economy, promotion of social modernization and cultural borrowings. The growth rate can be further improved due to investible tax revenues generated by foreign investment. On the other hand, the possible reduction in private sector's rate of saving may lower the growth rate. Although Caves acknowledges the possibility of spillover effects that raise the *level* of national income, he doubts their ongoing impact on the *rate* of growth.

Bhagwati and Srinivasan (1983, 296-297) apply the theory of *immiserizing growth* in the presence of FDI. They demonstrate the result established by Uzawa (1969) and Brecher and Diaz Alejandro (1977) that implies that a small inflow of capital into a small country with a distortionary tariff in place will immiserize the country if its importable good is capital intensive. The distortion leads to a result that private marginal product of capital exceeds its social marginal product. Brecher and Choudhri (1982) show that also a large host country with variable terms of trade can get immiserized, depending on the effect on the terms of trade (Bhagwati and Srinivasan 1983, 297-298).

Finally, MNCs are not only subject to host country policies but they respond to commands from the parent company or indirectly from other sovereign states. Hence the impact of FDI on national sovereignty has raised some concerns. Home government may interfere in political affairs of the host country through its control over the parent company. Host country's economic independence may be seriously reduced when foreign enterprises dominate a major share of host country's key growth industries. This tends to raise concerns about technological dependence on foreigners. Furthermore, by shifting resources within its international organization MNC can reduce the effectiveness of national programs, such as controlling inflation, improving the balance of payments and expanding employment. (Robock & Simmonds 1983, 232-236)

3.2 Indirect effects of FDI

Blomström and Kokko (1998) identify the prospect of acquiring modern technology as the most important reason for attracting FDI. Technology is interpreted to include product, process and distribution technology as well as management and marketing skills. Host country may gain from technology transfer even if MNCs internalize the transfer. Because of technology's nature as public good, FDI results in benefiting host country through externalities, often referred to as *productivity spillovers*. As a

definition, productivity spillovers are said to take place "when the entry or presence of MNC affiliates lead to productivity or efficiency benefits in the host country's local firms, and the MNCs are not able to internalize the full value of these benefits". Another type of spillovers, referred to as *market access spillovers*, result from MNCs' competitive advantages in entering world markets. The linkages with MNCs can provide local firms with transport infrastructure or information about foreign markets, which can help the local firms to establish direct exports of their own. (ibid., 247-248)

Spillovers can be categorized according to whether MNCs influence local firms in the same industry ('intra-industry spillovers') or their local suppliers and customers ('inter-industry spillovers'). Intra-industry spillovers consist of demonstration effects, effects on industry structure and training of local employees, all of which can be defined as productivity spillovers. Inter-industry spillovers refer to backward and forward linkages, which are often realized in the form of market access spillovers.[5] (Blomström 1990, 5-6) The following sections discuss the spillover concept in further detail.

3.2.1 Intra-industry spillovers

3.2.1.1 Demonstration effects

MNCs play an important role in introducing new technologies to host country firms. MNCs make local firms aware of specific technologies and may stimulate the adoption of the technology: without MNCs' presence local firms would have been unaware of the existence of the technology or would have felt it unprofitable to obtain the technology due to the uncertainty about it. Thus, the successful introduction of new products or processes by MNCs promotes the adoption of innovation more

[5] The categories presented here are partly overlapping: for example, management skills within MNCs may diffuse to other industries through demonstration effects or training of labor (this is the case of inter-

widely. The simplest example of this kind of spillover is the case of local firm copying some technology used by a MNC. (Blomström 1990, 7)

Demonstration effects and their importance are difficult to study scientifically: they generally take place unconsciously and documentation of learning about a new product or technology is often incomplete. Another reason lies in the interaction between demonstration effects and *competition*: in order to compete successfully with foreign multinationals local firms have to adopt more efficient procedures. (Blomström & Kokko 1998, 261-262)

3.2.1.2 Effects on industry structure

MNCs can increase the level of competition by entering markets characterized by high barriers to entry. MNCs are able to overcome barriers to entry more easily than domestic firms due to their larger resources, such as capital and R&D capacity. (Blomström 1990, 6) The greenfield entry of a MNC adds another seller in the market, thus reducing the market concentration, whereas entry by acquiring a national enterprise leaves initially the market structure unchanged (Caves 1982, 129).

According to Blomström and Kokko (1998; see Lall 1979) MNCs may actually increase the market concentration in the long run. Since MNCs are often larger and more efficient than their domestic rivals, they may force less efficient competitors to exit the market or promote local firm mergers and amalgamations. In addition, MNCs may be skillful lobbyist and induce the local government to add entry barriers and protection. (Blomström & Kokko 1998, 264)

The causality between multinational presence and seller concentration is difficult to establish. Another difficulty arises in assessing the effects of competition on

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industry productivity spillovers). Market access spillovers can also occur within the industry, although they are usually discussed in connection with inter-industry spillovers.

efficiency and welfare. The usual implicit assumption is that competition improves efficiency, but there are cases in which this assumption does not necessarily hold. First, the improvement in efficiency due to larger plant size and economies of scale may outweigh the loss resulting from reduced competition. The effect depends on market characteristics, like number of competitors, and trade policies, such as import protection. Second, the rate of technical progress may be higher in concentrated markets due to the availability of internally generated profits for R&D and larger firms' ability to enjoy economies of scale in their R&D operations. (Blomström & Kokko 1998, 264-265)

The increased competition brought by MNCs is usually assumed to improve the efficiency of the industry: the adoption of more efficient procedures by local firms leads to improved technical efficiency among firms that survive in the industry. The allocative efficiency is improved as the most inefficient firms are forced out of business. (Blomström & Kokko 1998, 261-262) However, the tightened competition may actually result in productivity *decreases* in local firms. According to Hanson (2001, 14-15) the intensive competition may lead to negative productivity spillovers as MNCs may drive domestic competitors to less profitable market segments. Aitken and Harrison (1999, 607) consider both positive spillovers and the adverse effect of competition on productivity: local firms gain from positive spillovers and are able to shift downwards their average cost curve, but the additional competition by foreign competitors may completely outweigh the gains. Foreign competitors with lower marginal costs draw demand from domestic firms, causing them to cut production. As a result, the productivity of domestic firms falls as firms spread their fixed costs over a smaller market, forcing them back up their average cost curves.

MNCs may crowd out domestic competitors not only on product markets but also on labor markets. In particular, skilled labor is often at least nearly fully employed. An increase in the number of MNCs or their operations raises the demand for skilled labor since MNCs are often skilled-labor intensive. Increased demand drives up

wages for skilled labor, resulting in substitution towards unskilled labor by local firms in the sector. This in turn leads to lower productivity. (Barry et al. 2001, 6-7)

3.2.1.3 Training of labor

As MNCs hire local employees, they usually offer various types of training ranging from on-the-job training to more formal schooling, possibly at the parent company overseas. Theoretically, employees should pay for the training they receive, typically in the form of lower wages during the training period. Quite conversely, MNCs usually pay higher wages than local firms, possibly in order to keep their employees from defecting to competing domestic firms. (Blomström et al. 1999, 17) The skills acquired when working for a MNC are transferred to local economy as employees move to local firms or set up their own businesses. Specifically, management skills are found to be less firm-specific than technical skills, thus they are more easily transferable. (Blomström & Kokko 1998, 259-260) This type of spillover is expected to be more important in less developed countries than in developed counties, since developing countries are typically scarce in skilled labor (Blomström 1990, 7).

3.2.2 Inter-industry spillovers

3.2.2.1 Backward linkages

Backward linkages arise from MNCs' relationships with local suppliers. These may be forced to improvements, as MNCs require high standards of quality, reliability and speed of delivery. Spillovers are also likely to arise from co-operation with multinationals, especially in the context of exporting activities. A MNC affiliate often has an advantage relative to local firms in export operations, since MNCs provide their affiliates with knowledge of international markets and access to established international marketing and distribution networks. Moreover, larger size allows for high fixed costs required to develop transport, communications and financial services.

The export operations of MNCs have both direct and indirect effects on local firms. (Blomström & Kokko 1998, 253)

Direct effects occur when MNCs employ local firms as suppliers or sub-contractors. Foreign market access, although it is realized through MNC instead of direct exports under own firm name, can benefit local firms: firms may be able to expand their output and achieve economies of scale due to the increase in demand. However, MNCs may be able to capture these direct benefits by negotiating lower prices. Accordingly, these direct consequences of FDI are usually not distinguished as spillovers. (Blomström & Kokko 1998, 253)

Still, it is likely that MNCs provide local firms with indirect gains, which are not so easily internalized. The contacts with MNCs provide information about foreign markets as well as product and process technologies, and this knowledge helps the local firm to establish direct exports to foreign markets. MNCs may also provide assistance in setting up production, raising the quality of products, purchasing raw materials and intermediaries, and diversifying by helping to find additional customers. The local exporters can also gain from transport infrastructure created by MNCs, their lobbying activities for trade liberalization or training of labor in export management. (Blomström & Kokko 1998, 253-258)

A formal model by Rodríguez-Clare (1996), examined in further detail in section 4.2, acknowledges also the possibility of *negative* linkage effect of MNCs. As MNCs establish in a country, they replace domestic firms in the labor market. When MNCs create *more* linkages with domestic upstream industries compared to domestic firms, upstream industry firms get an access to a larger stock of knowledge capital, in the form of intermediate inputs, which leads to productivity increases in these firms. In case MNCs create *less* linkages than domestic firms would do, domestic upstream industry firms experience a negative linkage effect and a decrease in their productivity.

3.2.2.2 Forward linkages

Forward linkages are created by MNCs' contacts with their customers. Purchases of new products supplied by MNCs may stimulate productivity improvements in domestic firms. Blomström (1990, 11-13) suggests that the importance of forward linkages is likely to increase in the future. Since the development of emerging technologies, such as microelectronics and information technologies, is generally very knowledge and research intensive as well as expensive, only large MNCs can afford such efforts. For small countries lagging behind the technological development it is more important to gain access to these new technologies than to produce them by themselves.

3.2.3 Determinants of spillovers

The two previous sections described the various types of spillovers. Understanding the determinants of scope and magnitude of spillovers is also essential, especially from policy maker's point of view. Blomström et al. (1999, 4) suggest that spillovers can be thought in a traditional market supply and demand context. Since foreign investors recognize the potential for host country firms to realize spillover benefits, technology made available to local firms (supply) is at least partly endogenously determined by the actions of foreign investors. Simultaneously, host country firms' demand for technology is determined by perceived costs and benefits related to the adoption of that technology.

MNCs incur both costs and benefits by allowing the technology to leak. On the cost side, making technology available to host country firms can reduce MNCs' future profits. An obvious benefit of allowing technology transfer is the reduction or avoidance of costs required to eliminate the risk of appropriation. These costs are smaller the more extensive and efficient the intellectual property protection offered by the host country is. MNCs may gain further benefits if making technology available facilitates acquisition of valuable technology from the host country, or if it

encourages host government to convey commercial advantages on the MNC. Finally, putting technology at risk for appropriation may increase efficiency within MNC's global network, for example due to easier and quicker transfer of technology from one affiliate to another. (Blomström et al. 1999, 5-6)

The demand for MNC technology by host country firms depends on expected costs required to absorb the technology and to benefit from it. The expected benefits, against which the costs must be weighed, are related to the expected cost reductions and/or increased revenues from the use of adopted technology. (Blomström et al. 1999, 7) The main proximate determinants of spillovers are summarized in Table 1.

Table 1. Proximate determinants of spillovers

Sign of effect	Supply	Sign of effect	Demand
(-)	Value of underlying technology	(+)	Value of underlying technology
(-)	Intellectual property protection	(-)	Costs of absorbing technology
(+)	Technology available in exchange		
(+)	Other commercial benefits		

Source: Modified from Blomström et al. 1999, 7

Spillovers can be influenced considerably by certain host country characteristics. The technical capability of local firms is among the most important determinants of spillover effects, since firms notably lagging behind MNCs cannot adopt very complex technology. However, it should be recognized that a certain technology gap is necessary for spillovers to occur. (Kokko 1994, 280) The supply of technology is also determined by whether the country succeeds in attracting MNCs in the first place. The attractiveness of a host country depends on characteristics like locational advantages, such as cheap factors of production, and the size and average income of the host country, which are related to demand for goods embodying intangible

capital. Technological centers-of-excellence in host country provide MNCs with potential for reverse technology flows. (Blomström et al. 1999, 8-9)

The influence of the degree of competition on the host markets is less clear. On the one hand, intensive competition may increase demand for appropriable technology, and MNCs may transfer more technology to their host country affiliates in order to enhance affiliates' ability to compete with local firms. On the other hand, local firms' demand for advanced technology may be reduced as intensive competition may relate to small anticipated profit opportunities from adopting foreign technology; simultaneously technology supply may be reduced, because MNCs may abandon the host market due to costs of losing firm-specific advantages. Host country government policy is another complex issue. Restrictions on foreign ownership may reduce inward FDI and thereby reduce the technology transfers, but the restrictions may as well encourage other forms of investment, such as joint ventures. (Blomström et al. 1999, 8-9) Table 2 summarizes the discussed variables that influence the technology transfer.

Table 2. Variables related to FDI spillovers

Sign of effect	Variable
(+)	Technological complementaries between MNC and host country firms
(+)	Size and wealth of host country
(+)	Technical centers of excellence in host country
(+)	Technical competence of host country firms
(+/-)	Competition in host country markets
(+/-)	Government policies

Source: Modified from Blomström et al. 1999, 10

4 SPILLOVERS AND HOST COUNTRY WELFARE: SOME MODEL SPECIFICATIONS

This chapter provides some formal model specifications related to spillovers from MNCs and resulting welfare effects. First, a simple model by Das (1987) describes MNCs in strategic environment, where the existence of technology leakages to local competitors in the host country complicates the choices of MNCs. This is the case of intra-industry spillovers, presented in the previous chapter by section 3.2.1. A model by Rodríguez-Clare (1996) examines the effect of MNCs through linkages, that is, the effect of MNCs' presence on the development of the supplier industries. Inter-industry spillovers were discussed at a conceptual level in section 3.2.2. Section 4.3 considers FDI promotion and its effect on welfare of the host economy, taking into account both intra- and inter-industry spillovers. The last section concludes the present chapter and discusses alternative models related to spillovers.

4.1 Technology transfer through MNCs and intra-industry productivity spillovers

The previous chapter ended with a discussion about the determinants of spillovers. On the supply side, MNCs' choices of how much technology to transfer and how to look at the technology leakages were discussed. Das (1987) models explicitly the choice problem of MNCs and examines their optimal behavior in the presence of technology leakages.

Das[6] assumes the domestic market to consist of a dominant market leader, the foreign subsidiary of a MNC, and a competitive fringe of domestic firms not colluding with each other. Domestic firms have a cost function, which is quadratic in its output, q, and inversely related to the efficiency of the firm. An increase in efficiency, obtained

[6] The model and the analysis presented here is based on Das (1987).

as a spillover effect[7] resulting from the operation of the MNC, is indicated by a downward shift of the marginal cost curve, that is, a rise in parameter A. Formally, the cost function is written as

$$(1) \qquad C=\frac{1}{b}\left[\frac{1}{2}q^2-(A-\overline{A})q\right]+\text{fixed cost},\ b, A, \overline{A}>0;\ A<\overline{A}$$

where $\overline{A}$ is the upper bound on A required to guarantee positive cost for all levels of output.

The model considers domestic firms' decision problem in static context, under the assumption that spillover effects and learning are costless. This would be the case for example when a domestic worker employed by a MNC opens his own firm. Das admits that in reality not all the leakages are costless: for example there are costs related to reverse engineering and hiring away personnel. When firms have to incur costs in order to increase their efficiency, the decision to learn becomes endogenous and the choice problem becomes dynamic. Wang and Blomström (1992) model spillovers under these more complicated assumptions in a paper, the results of which are presented later in this section.

Given the profit maximization objective, domestic firms produce the amount by which price P equals marginal cost:

$$(2) \qquad P=\frac{1}{b}\left[q-(A-\overline{A})\right].$$

Thereby, the supply function of each firm is given by

[7] The model does not distinguish between different sources of spillovers, that is, demonstration effects, competition effects and training of labor, as discussed in section 3.2.1.

(3) $$q = bP + A - \overline{A}.$$

The aggregate supply function of n domestic firms is thus given by $Q_c = nbP + n(A - \overline{A})$, which can be simplified to

(4) $$Q_c = bP + A - \overline{A}$$

by assuming that n, the number of domestic firms, is constant over time and setting n=1.

Das assumes that spillovers, the *change* in the efficiency of domestic firms in any period, $\dot{A}$, is directly related to Q_m, the amount of output produced by the MNC subsidiary during that period:

(5) $$\dot{A} = \alpha Q_m, \quad \alpha > 0.$$

This premise is backed by the assumptions that domestic labor is a non-inferior input into the production process of the foreign subsidiary and that spillovers to domestic firms are positively related to the employment of domestic labor by the foreign subsidiary.

For simplicity, the unit costs are assumed to be given for the MNC. Hence, the MNC's objective is to maximize the discounted sum of profits subject to the leakage effect:

(6) $$\max \int_0^T e^{-rt}(P - \theta c)\left[D(P) - bP - A + \overline{A}\right]dt$$
$$\text{s.t. } \dot{A} = \alpha Q_m,\ \alpha > 0,\ A(0) \text{ given},$$

where $Q_m = D(P) - bP - A + \overline{A}$ and $D(P) = a + D'P$ is the linear market demand function. r is the discount rate and θc is the unit cost. Variations in θ reflect changes in technology for the MNC's subsidiary; a fall in θ indicates a flow of new cost-saving techniques from the parent company.

The first-order necessary conditions for the maximum are[8], besides equation (5),

(7) $$D(P) - bP - A + \overline{A} + (D'-b)(P - \theta c + \lambda) = 0,$$

(8) $$\dot{\lambda} = \alpha(P - \theta c) + \lambda(r + \alpha),$$

(9) $$\lambda(T) = 0 \quad \text{(transversality condition)},$$

where $\lambda \equiv \alpha\mu e^{rt}$ represents the shadow price of learning by the domestic firms. It can be shown that λ is negative along the optimal time path.

The optimal pricing policy of the MNC at any given point of time is determined by equation (7). Without the spillover effect the profits of the MNC would be maximized as in the static case where $Q_m + (D'-b)(P - \theta c) = 0$, when $\lambda = 0$. But with negative λ, $Q_m + (D'-b)(P - \theta c) < 0$, and thereby the optimal price in dynamic environment is higher than in the static case by the magnitude of $(-\lambda)$, which can be interpreted as a 'markup' over the static price. A rise in price lowers the output by the MNC, which in turn leads to a lower rate of growth in the efficiency of the domestic firms and to a rise in MNC's profits. Algebraically, the price determined by the MNC can be written as

(10) $$P(t) = \frac{(\theta c - \lambda)(D'-b) - a + A - \overline{A}}{2(D'-b)},$$

[8] The Hamiltonian of the problem is $H = \left[e^{-rt}(P - \theta c) + \alpha\mu\right]\left[D(P) - bP - A + \overline{A}.\right]$

with $\partial P/\partial A = 1/2(D'-b) < 0$, $\partial P/\partial \lambda = -1/2 < 0$ and $\partial P/\partial \theta = c/2 > 0$. An increase in domestic firms' efficiency, a rise in the parameter A, indicates an increase in the supply by domestic firms and consequently, an inward shift of MNC's demand curve; as a result, the equilibrium price declines. Similarly, a rise in λ indicates a fall in the markup and a decrease in the market price. An increase in θ equals an increase in unit cost and thus, leads to an increase in price.

Using equations (5), (8) and (10) the following equations are obtained:

$$\dot{A} = (\alpha/2)\left[a + (\theta c - \lambda)(D'-b) - A + \overline{A}\right] \tag{11}$$

$$\dot{\lambda} = \left[\alpha/2(D'-b)\right]\left[-a - \theta c(D'-b) + A - \overline{A}\right] + \left[r + (\alpha/2)\right]\lambda \tag{12}$$

This is a pair of linear differential equations which can be solved explicitly, given the initial condition *A(0)* and the transversality condition (equation (9)):

$$\begin{aligned} A(t) &= A^* - \frac{A^* - A(0)}{L}\left[ke^{\eta_1 t + \eta_2 T} - \frac{1}{k}e^{\eta_1 t + \eta_2 t}\right], \\ \lambda(t) &= \frac{A^* - A(0)}{L(D'-b)}(e^{\eta_1 t + \eta_2 T} - e^{\eta_1 t + \eta_2 t}), \end{aligned} \tag{13}$$

where $\eta_2, \eta_1 = 1/2\left[r \pm (r^2 + 2\alpha r)^{1/2}\right]$ are the eigenvalues of the system, $k \equiv 1 + 2\eta_2/\alpha$, $L = ke^{\eta_2 T} - (1/k)e^{\eta_1 T} > 0$ and $A^* = \overline{A} + a + \theta c(D'-b)$, where a is the intercept of *D(P)*. It can be noted that $\eta_2 = r - \eta_1 = -k\eta_1$ and $e^{\eta_1 t + \eta_2 T} - e^{\eta_1 t + \eta_2 t} > 0$ for $0 \le t < T$. From (13) it can be seen that along the optimal time path A and λ are increasing.

Equation (5) implies that the efficiency of domestic firms is increasing over time as long as the output of the MNC's subsidiary, Q_m, is positive. However, the adverse effect of a marginal increase in A, measured by ($-\lambda$), on MNC's discounted profits is

declining over time, since λ is increasing and negative. Therefore, as can be seen from equation (10), the optimal price decreases over time.

Next, the optimal output of the MNC's subsidiary is determined. The decline in price should raise the output, whereas the rise in the efficiency of the MNC's rivals should lower it. Solving the time derivative of MNC's output yields

$$\frac{dQ_m}{dt} = (D'-b)\dot{P} - \dot{A} = \frac{1}{2}\frac{(A^* - A(0))}{L}\frac{\eta_2}{k}(k-1)\left[e^{\eta_1 T+\eta_2 t} - e^{\eta_1 t+\eta_2 T}\right] < 0 . \tag{14}$$

The decline of MNC's output over time results from the spillover process given in (5). MNC's best response to the rising efficiency of domestic firms is to lower the *rate* of the efficiency increase in domestic firms by lowering its output. Together with the falling price the decline in MNC's output leads to a decrease in MNC's profits over time. However, the falling price indicates an increase in demand, *D(P)*, which is met by an increase in the amount produced and sold by the domestic firms, since the output of the MNC is declining as noted above. The profits of the domestic firms, π_d, tend to increase due to the rise in A, while the decline in price tends to lower the profits. In equilibrium, price P equals marginal cost, and thus

$$\begin{aligned} \pi_d &= PQ_d - \frac{1}{b}\left[1/2Q_d^2 - (A-\bar{A})Q_d\right] - \text{fixed cost} \\ &= \frac{1}{2b}Q_d^2 - \text{fixed cost.} \end{aligned} \tag{15}$$

Hence, due to the increase in the output of the domestic firms, Q_d, the profits also increase over time.

Next, the attention is drawn to the welfare of the host country along the optimal path. Welfare can be measured by the sum of consumers' surplus and profits of domestic

firms. There are two effects which both favor the host country's welfare: first, the declining price increases consumers' surplus and second, as noticed earlier, the domestic firms' profits tend to increase as well.

The system analyzed above is based on a given level of technology used by the MNC's subsidiary. However, usually the parent company transfers technology to its subsidiary, which is indicated by a decline in the unit cost of the MNC, θ. The effects of a technology transfer on the efficiency level of the domestic firms and its shadow price towards the profits of the MNC can be determined by differentiating the optimal paths given in (13):

$$
\begin{aligned}
&\frac{dA(t)}{(-d\theta)} = -\frac{1}{L}\left[ke^{\eta_2 T}(1-e^{\eta_1 t}) + \frac{1}{k}e^{\eta_1 T}(e^{\eta_2 t}-1)\right](D'-b)c > 0, \\
&\frac{d\lambda(t)}{(-d\theta)} = -\frac{1}{L}(e^{\eta_2 T+\eta_1 t} - e^{\eta_1 T+\eta_2 t})c < 0.
\end{aligned} \tag{16}
$$

The equations in (16) confirm that technology transfer within the MNC increases the efficiency in domestic firms and the shadow price rises in magnitude, that is, λ falls. Moreover, by totally differentiating (10), it can be seen that technology transfer decreases the optimal price set by the MNC and increases the output produced and sold by the MNC:

$$
\begin{aligned}
\frac{dP(t)}{(-d\theta)} &= \frac{1}{2}\left[\frac{1}{(D'-b)}\frac{dA(t)}{(-d\theta)} - \frac{d\lambda(t)}{(-d\theta)} - c\right] \\
&= \frac{1}{2}\left[\frac{1}{(D'-b)}\frac{dA(t)}{(-d\theta)} + \frac{c}{L}\left(e^{\eta_1 T}\left(\frac{1}{k}-e^{\eta_2 t}\right) + e^{\eta_2 T}(e^{\eta_1 t}-k)\right)\right] < 0, \\
\frac{dQ_m(t)}{(-d\theta)} &= \frac{1}{2}\frac{(D'-b)c(1-k)}{L}\left(\frac{1}{k}e^{\eta_2 T+\eta_1 t} + e^{\eta_2 T+\eta_1 t}\right) > 0.
\end{aligned} \tag{17}
$$

As can be seen from (17), the positive effect of the decrease in unit production cost, θ, due to the technology transfer, outweighs the negative effect of the improved efficiency in the domestic rival firms on the output level of the MNC's subsidiary. Therefore, the MNC allows the *rate* of growth in efficiency of the domestic firms to increase. It can be shown that MNC's subsidiary benefits from the technology transfer from the parent company despite of the leakage of knowledge to the host country firms:

$$\frac{d\pi_m(t)}{(-d\theta)} = \frac{-c}{2L}\left[(D'-b)(P-\theta c)(1-k)\left(\frac{1}{k}e^{\eta_1 T+\eta_2 t}+e^{\eta_2 T+\eta_1 t}\right)\right. \\ \left. +Q_m(1+k)\left(e^{\eta_2 T+\eta_1 t}-\frac{1}{k}e^{\eta_2 T+\eta_1 t}\right)\right]>0 \tag{18}$$

The effect of a fall in the unit cost, θ, on the output of the domestic firms is ambiguous: the output produced tends to decrease with the declining price and increase with the increasing efficiency. The net effect can be written as

$$\frac{dQ_d(t)}{(-d\theta)} = \frac{c}{2L}\left[2D'\left(\frac{1}{k}e^{\eta_1 T}(1-e^{\eta_2 t})+ke^{\eta_2 T}(e^{\eta_1 t}-1)\right)\right. \\ \left. +\frac{b(1-k)}{k}\left(e^{\eta_1 T+\eta_2 t}+ke^{\eta_2 T+\eta_1 t}\right)\right] \tag{19}$$

Hence, the effect on the profits of the domestic firms remains also ambiguous:

$$\frac{d\pi_d(t)}{(-d\theta)} = \frac{Q_d}{b}\frac{dQ_d(t)}{(-d\theta)}. \tag{20}$$

Thus, it is not evident that technology transfer benefits host country's domestic firms. However, from equation (19) it can be seen that the higher the magnitude of the slope of the demand curve, $|D'|$, the more likely it is that the domestic firms will benefit.

The reason is that steeper demand curve implies a greater increase in the output of the MNC's subsidiary as a result of the lower price, and thereby the domestic firms become more efficient. In addition, the lower the slope of the domestic supply curve the more likely the domestic firms benefit since the decline in price does not decrease their output as much.

Although the effect of technology transfer on profits of the domestic firms remains ambiguous, it can be shown that the welfare of the host country as a whole increases unambiguously. The change in welfare (defined as the sum of consumers' surplus and profits of domestic firms) along the optimal path is given by

$$(21) \qquad \frac{dW(t)}{(-d\theta)} = -\frac{D(P)dP(t)}{(-d\theta)} + \frac{D\pi_d(t)}{(-d\theta)}.$$

Using equation (15) and $dQ_d = Q_d dp + (Q_d / b)dA$, yields

$$(22) \qquad \frac{dW(t)}{(-d\theta)} = [Q_d - D(P)]\frac{dP(t)}{(-d\theta)} + \frac{Q_d}{b}\frac{dA(t)}{(-d\theta)} > 0.$$

In sum, technology transfer within the MNC increases the efficiency of the domestic firms, but due to the decline in price, the effects on domestic firms' profits remain ambiguous. The output and profits of MNC's subsidiary increase and the host country as a whole is better off.

Wang and Blomström (1992) develop a model of international technology transfer under more realistic assumptions: the model recognizes the costs of technology transfer within the MNC and the learning costs faced by the host country firms. Technology transfer is assumed to become cheaper as the technology transferred becomes older due to the 'learning by doing' -effect. According to Wang and Blomström, there is almost no free copying of technologies in the world, but on the

contrary, domestic firms in the host country face an investment decision on how much resources to devote on learning. Furthermore, the model assumes that the market demand for the products of the MNC and the domestic firms depends on the attractiveness of the products, determined by the technology difference between the foreign and domestic firms. Hence, the narrower the technology gap, the more competitive the domestic firms are. (ibid., 139-141)

The domestic firms' technology level is an increasing function of their learning investment, subject to diminishing returns. As usual, the rate of technological progress is assumed to be an increasing function of the technology gap. Since the model assumes that there exist also costless spillovers, MNC's technological lead will be eroded over time although the domestic firms would be totally passive and invest nothing in learning. Therefore, in equilibrium the MNC transfers some technology. In the steady state, prices are constant and each firm's output and market share are constant. Technology transfer improves the products of both foreign and domestic firms and firms earn profits over time. Also the consumer's utility increases. (Wang & Blomström 1992, 143-146)

Wang and Blomström (1992) propose that given the learning efforts of domestic firms, MNC's technology transfer is negatively related to the operation risk in the host country. On the other hand, the technology transfer is positively related to the level of domestic firms' learning investment. Technologies are transferred more rapidly and more modern ones are transferred the lower the domestic firms' discount rate is, the more efficient the learning activities and the more responsive the profit functions of the firms to the technology gap are. The costless spillovers contribute also to the rate of technology transfer: the transfer is faster the more there are costless technology spillovers from foreign to domestic firms. (ibid., 146-148)

Wang and Blomström (1992) notice that investments in learning are often below the optimal level in the host countries. This results from high real rates of interest and

externalities related to learning investment: the learning processes of domestic firms are interrelated by an unavoidable transmission of information. Thus, Wang and Blomström's model suggests that in order to increase the rate of technology transfer by MNCs, host country policies should be aimed at supporting learning efforts of the domestic firms. These policy measures would be welfare enhancing as long as the resulting benefits outweigh the costs associated with the policies. However, as Wang and Blomström point out, this conclusion is derived under certain assumptions and should be treated with care. (ibid., 149-153) The welfare effects of FDI subsidies are modeled under different assumptions in section 4.3.

4.2 The effects of MNCs through linkages

Rodríguez-Clare (1996) explores the effect of MNCs through the generation of linkages[9]. By increasing the demand for inputs a final-good producer contributes to a greater variety of specialized inputs, which generates a positive externality to other final good producers. This is how Rodríguez-Clare defines the concept of backward linkages. Forward linkages, in turn, result from local production of more specialized inputs, which allows the production of more complex goods at competitive costs. According to this definition, backward linkages are a necessary condition for the materialization of forward linkages; hence, the focus of the paper is on backward linkages.[10]

The model is built on three premises:

- production efficiency is enhanced by the use of wider variety of specialized inputs,
- the proximity of supplier and the user is essential for these inputs,
- the size of the market limits the availability of specialized inputs.

[9] Linkages between MNCs and local firms across industries were discussed in section 3.2.2.
[10] The source of this section is Rodríguez-Clare (1996) unless otherwise noted.

These premises are captured by assuming there is love of variety for inputs in the production of final goods, domestic firms have to buy there inputs locally and inputs are produced with increasing returns to scale.

Rodríguez-Clare shows that when backward and forward linkages exist, an economy may exhibit multiple Pareto-rankable equilibria. In the 'good' equilibrium the economy specializes in the production of complex final goods that uses a large variety of specialized inputs and the wage-level is high. In the 'bad' equilibrium, the economy specializes in the production of simple, labor-intensive final goods using a low variety of specialized inputs and the wage-level is low.

The coexistence of developed and underdeveloped economies (that is, economies in good and bad equilibrium) gives rise to multinational production: a final good producer benefits from locating its headquarters in the developed economy and production plant in the poor economy. In this way a MNC has access both to the wider variety of specialized inputs and to cheap labor force. By assumption, domestic firms in the poor economy cannot import specialized inputs from another country – in fact, specialized inputs are assumed to be nontradable, but can be used as headquarter services by the MNC. One interpretation of intermediate inputs is that they represent knowledge capital, to which MNCs give less developed countries access.

The impact of MNCs on the less developed economy is examined by comparing the linkages created by MNCs to the linkages that would be created by domestic firms replaced by MNCs in the labor market. The measure used by Rodríguez-Clare is called the *linkage coefficient of the firm*, defined as the ratio of employment generated in upstream industries to the labor hired directly by a firm. A MNC is said to have a *positive linkage effect* when its linkage coefficient is higher than that of domestic firms. This leads to higher variety of specialized inputs in equilibrium. Due to the assumption of love of variety for inputs, positive linkage effect leads to an increase in productivity of domestic firms and a consequent increase in wages. A

negative linkage effect, a result of a MNC having lower linkage coefficient than domestic firms, has the opposite effect on productivity and wages in an economy.

The model assumes two countries, A and B, with immobile labor force L_R $(R = A, B)$. There are three types of goods: final goods z and y, and an intermediate good x, which is available in a continuum of varieties. Variety is indexed by number j. Final goods z and y are traded freely in the world market at international prices P_z and P_y, which cannot be influenced by the producer countries, both of which are assumed to be small. The intermediate good x is nontradable and therefore the variety j is available in country R only if it is actually produced in that country. Number $n_R \geq 0$ denotes the measure of varieties of x produced in country R, that is, variety j is available in country R if $j \leq n_R$. The price of variety j is denoted by $p^R(j)$.

Each variety of intermediate good x is produced with a decreasing average cost technology: in addition to a fixed requirement of one unit of L each additional unit of $x(j)$ requires one unit of L. Final goods, in turn, are produced with a Cobb-Douglas production function using labor and a composite of intermediate good, X, consisting of a continuum of differentiated intermediate goods. Hence, the production functions can be expressed as

(1a) $$Q_s = \delta(s) L_s^{\beta(s)} X_s^{1-\beta(s)}, \qquad s=z,y,$$

(1b) $$X_s = \left(\int_0^n x(j)_s^{\alpha} \, dj \right)^{1/\alpha}, \qquad s=z,y,$$

where $\delta(z), \delta(y), \beta(z), \beta(y)$ and α are constant parameters and it is assumed that $\beta(z), \beta(y), \alpha \in (0,1)$. The assumption $\beta(z) > \beta(y)$ implies that the y industry uses intermediate goods more intensively than the z industry.

The production function for the good s can be further modified to

$$(2) \qquad Q_s = \delta(s) n^{\phi(s)} L_s^{\beta(s)} L_x^{1-\beta(s)}$$

where $\phi(s) \equiv (1-\beta(s))(1-\alpha)/\alpha$ and $L_x = \int_0^n x(j)dj = nx$ denotes the amount of labor required for the production of intermediate goods, excluding the fixed labor requirement for each variety.[11] Equation (2) implies that an increase in the variety of intermediate goods increases total factor productivity in the production of final goods. Since $\beta(z) > \beta(y)$ then $\phi(y) > \phi(z)$, which indicates that producers of y have stronger love of variety for inputs.

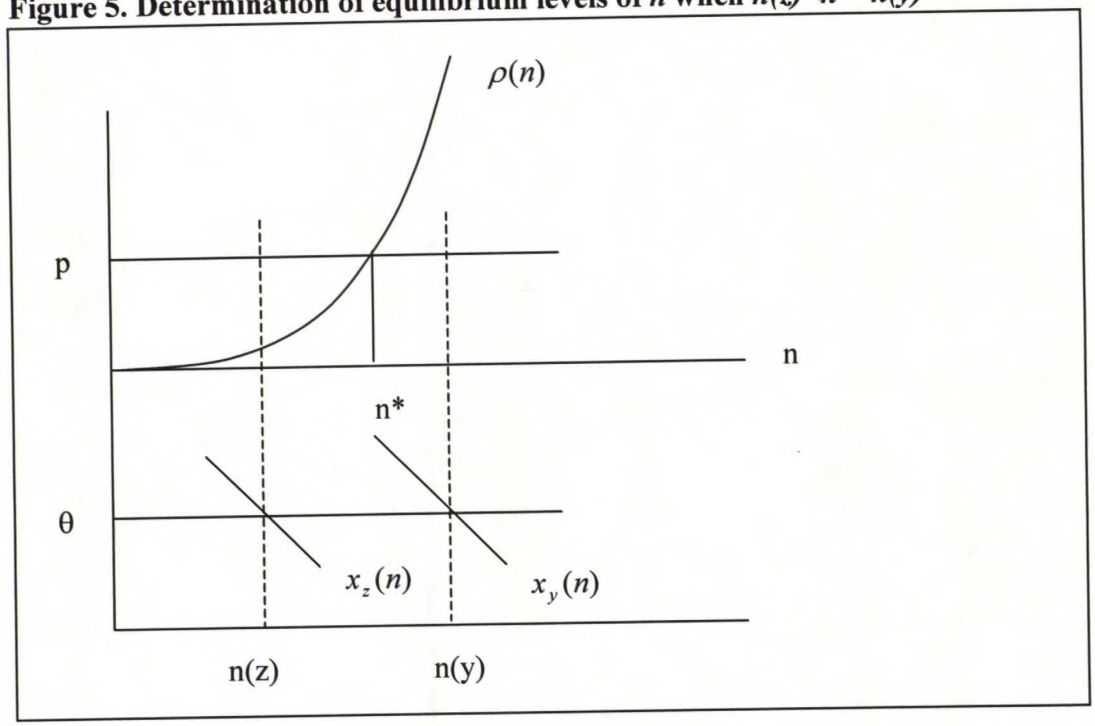
In the intermediate goods sector there is monopolistic competition: each variety j of x is produced by a single firm, which then chooses price $p(j)$ to maximize profits. This is because each firm producing a variety of the intermediate good is better-off by choosing a variety that is not already being produced by another firm. Due to MNCs and their ability to buy intermediate goods from both countries, this logic applies across borders: firms in countries A and B produce different varieties of x. The index k implies that if variety j is produced in a country, all varieties $k<j$ are also produced there.

Next, equilibria for countries A and B are derived independently, assuming no MNCs and hence, no interaction between the two countries. It can be shown that, for a given level of n, the marginal rate of transformation between z and y is constant, that is, the production possibilities frontier is linear. The ratio of unit costs can be written as

$$(3) \qquad c_z / c_y = \rho(n) \equiv \alpha^{\beta(z)-\beta(y)} n^{\phi(y)-\phi(z)}.$$

Except for the case where $p \equiv P_z / P_y = \rho(n)$, there will be complete specialization in the production of final goods. There will be complete specialization in the production of y if $\rho(n) > p$, and in the production of z in the opposite case. $\rho(n)$ is increasing since $\phi(y) - \phi(z) = (\beta(z) - \beta(y))(1-\alpha)/\alpha > 0$ (illustrated by the curve in Figure 5). Since the production of y is more intensive in the use of intermediate products, it benefits relatively more from an increase in the variety of intermediate goods: an increase in n leads to a fall in the unit cost of y relative to z. Hence, there is a level of n^* such that if $n>n^*$ there is complete specialization in y (complete specialization in z in the opposite case), as can be seen in Figure 5.

Figure 5. Determination of equilibrium levels of n when $n(z)<n^*<n(y)$



Source: Rodríguez-Clare (1996, 857)

[11] Due to convexity and symmetry among varieties of x, efficiency requires that final good firms use the same quantity of all available varieties, that is $x(j) = x$ for all $j \leq n$. Thus, the production functions in (1) imply that there are returns from the division of labor in the production of intermediate goods.

The equilibrium level of n is determined by the zero-profit condition for intermediate good producers. All monopolists maximize profits by charging a fixed mark-up over marginal cost, $p(j) = w/\alpha$, and they make zero-profits if at that price they sell a quantity equal to $\theta \equiv \alpha/(1-\alpha)$. Hence, the zero-profit condition for intermediate goods sector is

(4) $\qquad x(j) = \theta \qquad$ for all j.

Given the price $p(j) = w/\alpha$, the quantity of each variety of intermediate good that producers of final good s purchase per unit of labor hired, v_s, can be expressed as

(5) $\qquad v_s(n) = \alpha m(s)/n,$

where $m(s) \equiv (1-\beta(s))/\beta(s)$. Hence, when there is complete specialization in final good s, the zero-profit condition for the intermediate good sector is $v_s(n)L_s = \theta$, where L_s is the total quantity labor hired by firms producing final good s. Combining this result with the full-employment condition $L = n + nv_s(n)L_s + L_s$, the quantity sold by each input producer can be explained as a function of n, $x_s(n)$, shown as two downward sloping lines $x_z(n)$ and $x_y(n)$ in Figure 5.

When n^* lies in the interval *[n(z), n(y)]*, as in Figure 5, there are multiple equilibria. If $n=n(z)$, then $n<n^*$ and there is complete specialization in final good z and the zero-profit condition holds. Similarly, if $n=n(y)$, then $n>n^*$ and there is complete specialization in final good y. Outside the interval *[n(z), n(y)]* there is a single equilibrium: in case $n^*<n(z)$ final good producers specialize in good y, while in case $n^*>n(y)$ final good producers specialize in good z.

Next, the wage level, $w_s(n)$, is defined for a given level of n, when there is a complete specialization in final good s. Using the zero-profit condition for producers, $c_s = P_s$, yields

$$w_s(n) = P_s \alpha^{1-\beta(s)} n^{\phi(s)}. \tag{6}$$

The wage level can be shown to be higher in the equilibrium with complete specialization in y (the product using intermediate goods more intensively) than in the equilibrium with complete specialization in z. Given the zero-profits in equilibrium, this implies that there is a coordination failure in z equilibrium: the economy would be better-off in the Pareto superior y equilibrium. However, there is no incentive to an individual firm to produce y given the small variety of intermediate goods in the economy; on the other hand, it is not profitable to produce a new variety of the intermediate good due to the low demand for intermediate goods in economy specialized in the production of z. This in turn indicates that firms have an incentive to become multinational, when countries in y (good) and z (bad) equilibrium coexist. The country A in the good equilibrium has a lower shadow price of the composite input X while the wage level in country A is higher than in B, which is in bad equilibrium. By becoming multinational, a firm is able to buy specialized inputs from country A and hire labor from country B.

The transfer of the composite input from one country to another is subject to a transportation cost τ, also referred to as a communication cost, as it is likely that the most important part of the composite input is in fact information. Furthermore, it is assumed that workers differ in their management abilities: the size of the production plant in terms of the number of employees sets requirements for managers with high abilities. This ability is measured by an index i assigned to each person: a person indexed i can hire no more than $h(i)$ workers for the production plant.

To simplify the analysis, the variety of intermediate goods produced in country A, n_A, and the number of MNCs, M, are assumed to be exogenous and fixed. In addition, MNCs' headquarters are located only in country A and they all specialize in the production of final good y. Next, the equilibrium in intermediate good sector in country B is derived by determining the level of n at which there are zero profits.

The set of people managing MNCs in country A is $\{i : i \leq M\}$ and the quantity of labor hired by MNCs in country B is $L_m(M) \equiv \int_0^M h(i)di$. As defined earlier, $v_s(n)$ denotes the quantity of each variety of intermediate good that producers of final good s purchase per unit of labor hired, while $v_m(n)$ is defined as the quantity of each variety of intermediate good produced in country B that MNCs demand per unit of labor hired in that country. Given the complete specialization of country B in final good z, the full employment condition can be written as

$$L = n + nv_z(n)L_z + nv_m(n)L_m + L_z + L_m(M). \tag{7}$$

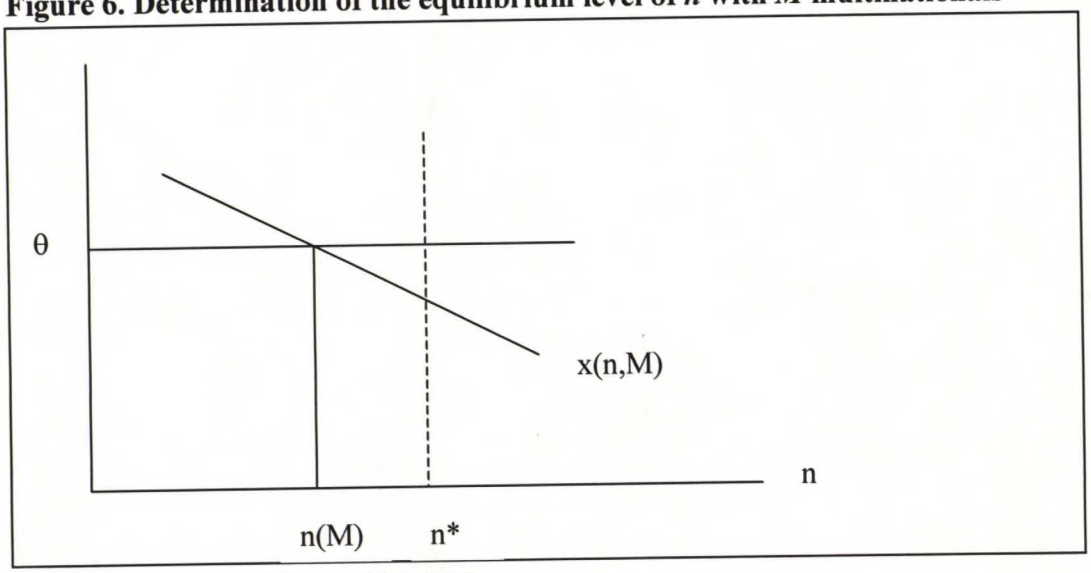
The total demand for labor by the producers of intermediate goods can be defined as a function of n and M: $L_x(n,M) \equiv nv_z(n)L_z + nv_m(n)L_m(M)$. Combining this with equation (7) yields

$$L_x(n,M) = (L - n - L_m(M))\frac{nv_z(n)}{1+nv_z(n)} + \frac{nv_m(n)}{1+nv_z(n)}L_m(M). \tag{8}$$

Due to the symmetry of producers of varieties of intermediate good x, each of them sells $x(n,M) \equiv L_x(n,M)/n$ when n is given. The zero profit condition is given by $x(n,M) = \theta$. As illustrated in Figure 6, the horizontal line θ and the intersection of the curve $x(n,M)$ determines the level of n at which the producers of x earn zero

profits. This determines the equilibrium in country B as long as $n(M)<n^*$, which applies by definition: domestic producers in country B specialize in production of final good z.

Figure 6. Determination of the equilibrium level of n with M multinationals



Source: Rodríguez-Clare (1996, 860)

Next, the effect of MNCs on the wage level in country B is considered. The wage level in country B is determined by equation (6), so the impact of MNCs depends on how M affects the equilibrium variety of intermediate goods in country B. The sign of the partial derivative, $\partial L_x / \partial M$, determines how M affects the curve $x(n,M)$ (since $\partial x / \partial M = (1/n)(\partial L_x / \partial M)$). If the sign is positive at $x(n;M) = \theta$, an increase in the number of MNCs, M, leads to an increase in the demand for the intermediate goods at $n(M)$ and consequently, an increase in n and w. The opposite is true for a negative sign of the partial derivative.

From equation (8) it can be noted that

(9) $$\text{sign}(\partial L_x / \partial M) = \text{sign}(nv_m(n) - nv_z(n)),$$

where $nv_z(n)$ and $nv_m(n)$ represent the level of employment generated in the intermediate goods sector per unit of labor hired by domestic and multinational final goods producers. This factor is the *linkage coefficient* of a firm introduced in the beginning of the section. Therefore, given n_A, an increase in M generates an increase in n and w if the linkage coefficient of MNCs is higher than the linkage coefficient of domestic firms, that is, if $nv_m(n) > nv_z(n)$. The opposite occurs if the linkage coefficient of MNCs is lower than the linkage coefficient of domestic firms. In other words, the more beneficial MNCs are to the host economy the higher their linkage coefficient is.

When MNCs establish in a country, they displace domestic firms in the labor market. If MNCs have a lower linkage coefficient than domestic firms, they decrease the total demand for intermediate goods by hiring away labor from domestic firms. This leads to a decrease in varieties of the intermediate good and due to love of variety, also wages decrease in equilibrium. This is a negative linkage effect. An interesting implication of this result is that MNCs with positive linkage effect could actually push the varieties of x above n^*: at that point domestic firms of country B would also start producing final good y, and country B would shift to the good equilibrium.

The section continues with examination of the factors that determine the sign of the linkage effect. To maximize profits, MNCs demand an amount of X per unit of labor hired equal to $\psi(y)(P_y / P_{xm})^{1/\beta(y)}$, where $\psi(s) \equiv [\delta(s)(1-\beta(s))]^{1/\beta(s)}$ and P_{xm} is the shadow price of X for MNCs. X_m, defined as the total demand for X by MNCs, can be written algebraically as

$$X_m = \psi(y)(P_y / P_{xm})^{1/\beta(y)} L_m(M). \tag{10}$$

The demand for an individual variety of x in country B is determined as

(11) $$x_m(j) = p^B(j)^{-\theta/\alpha} P_{xm}^{\theta/\alpha} X_m .$$

Combining equations (10) and (11) with notion that $p^B(j) = w_z(n)/\alpha$ finally yields

(12) $$v_m(n) = \psi(y) P_y^{1/\beta(y)} (w_z(n)/\alpha)^{-\theta/\alpha} P_{xm}(n)^{\theta/\alpha - 1/\beta(y)},$$

where

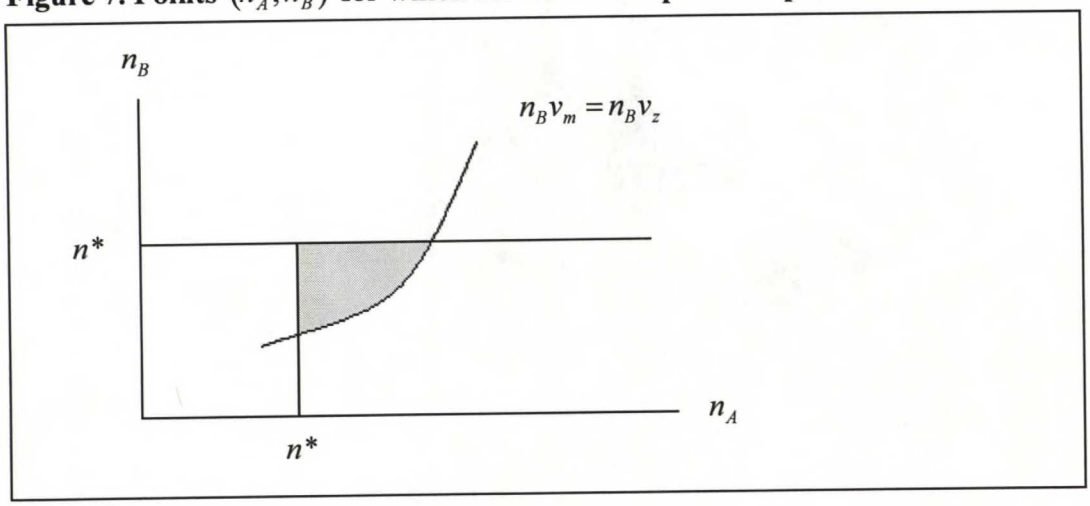
(13) $$\begin{aligned} P_{xm}(n) &= \left(\int_0^{n_A} \left[p^A(j)/(1-\tau) \right]^{-\theta} dj + \int_0^{n_B} p^B(j)^{-\theta} dj \right)^{-1/\theta} \\ &= \left((1-\tau)^{\theta} P_{xA}^{-\theta} + P_{xB}(n)^{-\theta} \right)^{-1/\theta} \end{aligned}$$

with P_{xR} representing the shadow price of the composite input X for domestic firms in country R. Due to love of variety, $P_{xB}(n)$ is decreasing in n, and so is $P_{xm}(n)$, as equation (13) implies. Therefore, equation (12) indicates that $nv_m(n)$ also decreases with n as long as the elasticity of substitution between varieties of x is higher than the price elasticity of the demand for X by MNCs. Formally this requirement can be written as $\theta/\alpha > 1/\beta(y)$. This is sufficient condition to ensure the stability of equilibrium, and this inequality is assumed to hold.

Now the zero-linkage-effect curve, defined as $n_B v_m(n_A, n_B) = n_B v_z(n_B)$, is drawn in Figure 7. Given that $n_B v_z(n_B)$ is constant, the slope of the curve is determined by the way that the linkage coefficient of MNCs, $n_B v_m(n_A, n_B)$ varies with n_A and n_B. It can be shown that the linkage coefficient of MNCs is decreasing in n_A and increasing in n_B. In other words, an increase in n_A makes MNCs spread their demand on intermediate goods more thinly across more varieties; as a result, demand for each variety of x falls. But then again, an increase in n_B leads MNCs to reallocate their input purchases to country B so that $n_B v_m$ increases, since the condition

$\theta/\alpha > 1/\beta(y)$ ensures that the elasticity of substitution is high enough. Thus, the zero-linkage-effect curve in Figure 7 is upward sloping; points above the curve represent a positive linkage effect whereas points below the curve represent a negative linkage effect.

Figure 7. Points (n_A, n_B) for which MNCs have a positive spillover effect



Source: Rodríguez-Clare (1996, 863)

Given the initial assumption that economy A is specialized in production of y while the economy B is specialized in production of z, implying that $n_B < n^* < n_A$, there is a region where the linkage effect is positive only if the zero-linkage-effect curve lies below the point (n^*, n^*). The condition to be satisfied can be formally written as

$$\frac{m(y)}{m(z)} > (1+(1-\tau)^{\theta})^{1-m(y)/\theta}. \tag{14}$$

The linkage effect is more likely to be positive when $m(y)$ is high compared to $m(z)$, which reflects the fact that MNCs produce a more complex good than domestic firms. Hence, MNCs tend to demand a higher quantity of intermediate goods per unit of labor hired, but due to their access to inputs from country A this demand is only partially met by intermediate products of country B. The lower the communication

cost τ, the smaller part of the demand of inputs by MNCs is exerted in country B, which in turn lowers the likelihood that the linkage effect is positive. Besides, the level of n in country B relative to n in country A contributes to the likelihood of positive linkage effect: when n_B is not too small in comparison to n_A, so that (n_A, n_B) lies in the shaded area of Figure 7, the linkage effect of MNCs is more likely to be positive.

The result noted earlier, that $nv_m(n)$ is decreasing in n_A, implies that the linkage coefficient of MNCs is smaller the more varieties of intermediate good x are available in the home country A. This leads to a rather surprising result: MNCs from rich countries, characterized by high n, are less beneficial to the host economy than MNCs from less developed countries with low n. This result should be treated with care, however, since MNCs from less developed countries are more likely to produce rather simple goods, which tends to decrease the linkage coefficient.

Finally, the assumption that n_A and M are exogenous constants is relaxed. The equilibrium level of MNCs, M^*, is determined by means of the zero profit condition for MNCs having their headquarters in country A and specializing in production of y:

$$h(M^*)g_{my}^{A} = w_A, \tag{15}$$

where g_{my}^{A} denotes the operating profits of MNCs per unit of labor hired. It can also be shown that in equilibrium MNCs actually do prefer to produce y rather than z and there are no incentives to locate headquarters in country B. Next, the equilibrium number of MNCs is assumed to increase as a result of a subsidy or a tax break offered to MNCs operating in country B. The increase in M results in an increase in demand for intermediate goods in country A, increasing x_A. On the other hand, MNCs hire managers and decrease the quantity of labor left in country A for domestic firms, thus

decreasing x_A. However, the latter effect is assumed to be rather small, the net effect thus being an increase in x_A.

What happens to the varieties of x in country B, n_B, as a result of an increase in M depends on the direct and indirect consequences of the operation of MNCs in country B. The increase in the number of MNCs increases directly the demand for varieties of intermediate good produced in country B, thus increasing n_B. On the other hand, the indirect effect works in the opposite direction: the increase in n_A reduces MNCs' demand for intermediate goods produced in country B. The negative effect on n_B is smaller the smaller the presence of MNCs in country B *(M)* is, or the larger the communication cost (τ) is. Nevertheless, the linkage effect of MNCs on the host economy is less favorable when n_A is allowed to change in response to changes in M.

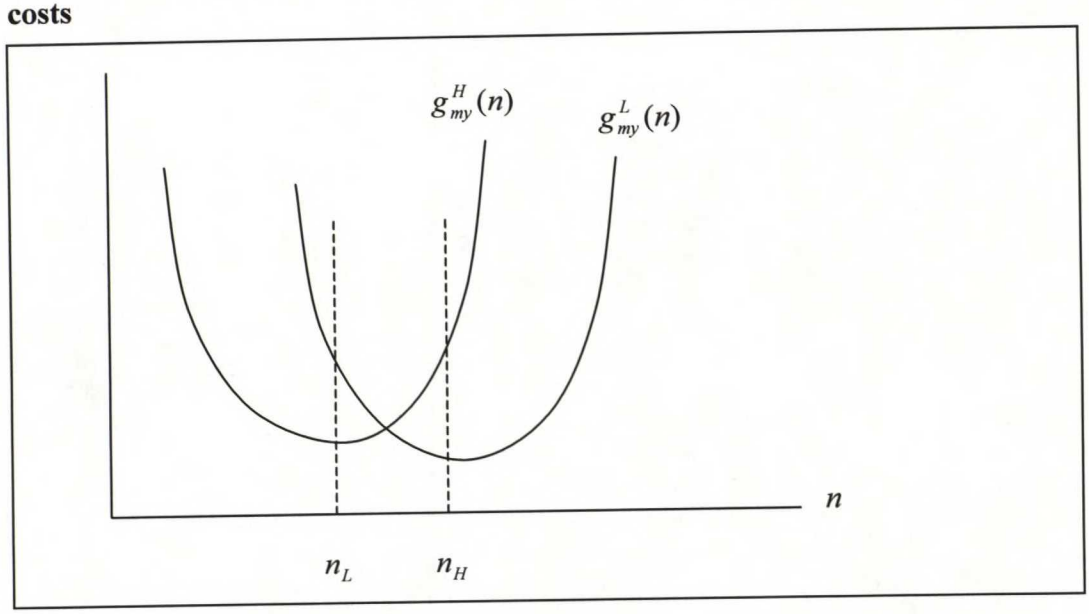
The analysis above indicates that less developed countries would benefit from the presence of MNCs with high linkage coefficient. However, it is not evident that a MNC chooses to locate its production facility in a poor economy. This can be seen when considering the optimal choice of two MNCs that differ only in their communication cost τ. Differentiating the MNCs operating profits g_{my} in relation to n, varieties of intermediate goods in the host country, yields

$$\partial g_{my} / \partial n = (\phi(z) / \alpha m(z))(v_m - v_z)w, \tag{17}$$

where v_m is the demand for each variety of x produced in the host country that MNCs demand per unit of labor hired in that country. As illustrated by Figure 8, $g_{my}(n)$ is first decreasing, reaches a minimum for some n and increases with n thereafter. Thus, MNCs prefer countries with either very low or very high n.

Figure 8 depicts the operating profit functions of MNCs that differ in their communication cost: the curve $g_{my}^{H}(n)$ illustrates MNCs with high communication cost and the curve $g_{my}^{L}(n)$ MNCs with low communication cost. If there are two possible host countries that differ in n, either both types of MNCs choose to locate in the same country or the MNC with low communication cost (and therefore, lower linkage coefficient) prefers the country with low n, while the MNC with high communication cost (indicating higher linkage coefficient) prefers the country with high n. In other words, poor regions tend to attract firms with low linkage potential.

Figure 8. Choice of location by MNCs characterized by different communication costs



Source: Rodríguez-Clare (1996, 865)

4.3 FDI promotion

The existence of positive spillovers, presented in chapter 3, raises the question, whether countries should promote FDI in order to induce more spillovers and hence, to enhance welfare. Subsidies to MNCs' production are often found in practice, notably in less developed countries. As noticed in the introductory chapter, also

developed countries have provided substantial subventions to attract MNCs. However, chapter 3 pointed out that in addition to many positive spillover effects there may be negative effects as well, such as lower market share and lower profits to domestic firms due to intensified competition. These adverse impacts of FDI should be taken into account as well as direct costs of subsidies when assessing FDI promotion.

Hanson (2001, 3-9) describes subsidies to inward FDI basing his summary on annual editions by PriceWaterhouse. Most of the countries promoting FDI grant exemptions from corporate income tax, which usually last less than a decade. Exemptions from import duties tend to be restricted to inputs used for producing export goods or to capital goods. Exemptions from value added taxes are for the most part tied to participation in export activities or officially designated priority sectors or regions. These concessions are usually also available to domestic firms. Direct subsidies on a case by case basis are also common arrangements.

Hanson[12] focuses on the issue of whether spillovers created by production of MNCs are sufficient to justify subsidies to FDI. Creating a simple theoretical model, Hanson derives conditions under which subsidies to FDI would raise the welfare of the host economy: (1) MNCs are intensive in the use of elastically-supplied factors, (2) the arrival of MNCs does not lower the market share of domestic firms and (3) FDI creates strong positive productivity spillovers for domestic agents.

To start with, the following effects of MNCs are considered: the arrival of a MNC

- raises the demand for labor and other factors, hence raising factor incomes,
- crowds domestic firms out of the market by bidding away resources and capturing market share,
- generates spillovers, which may raise or lower the productivity and profitability of domestic firms.

Hanson takes into consideration spillover concept in its widest possible perspective. First of all, he acknowledges the possibility of negative spillovers, resulting for example from the competition with MNCs that drives domestic firms to less profitable market segments. Second, Hanson's model takes into account productivity spillovers that contribute to the efficiency of *all* industries, not only the one where domestic firms compete directly with the MNC. Therefore, the model is able to capture the effects of both intra-industry and inter-industry spillovers, which were discussed in sections 3.2.1 and 3.2.2.

The host economy of the model has two sectors: perfectly competitive agricultural sector, which hires unskilled labor, and imperfectly competitive manufacturing sector consisting of N industries and employing both skilled and unskilled labor. Agriculture is defined as the numeraire for the economy, and the units of the good produced are defined so that it takes one unskilled worker to produce one unit of output. Thereby the price of the good and the wage for unskilled labor both equal to one. Skilled labor is a scarce resource, representing managers and other high-skill employees in technology intensive, imperfectly competitive industries. Each of the N manufacturing industries contains one domestic firm, which Cournot-competes with a foreign firm in a world market[13]. A foreign firm in industry 1 contemplates locating production in the host country. These assumptions indicate that firms have price-setting power on world markets.

The model is based on the following detailed assumptions:

- Inelastic supply of factors: there are l units of unskilled labor and k units of skilled labor earning wage z. x represents total agricultural output. (a1)
- Possibility for different unit factor demands by foreign and domestic firms: To produce one unit of output, a domestic firm in industry i requires a_i units of unskilled labor and one unit of skilled labor. If the foreign firm in industry

[12] Rest of the section is based on Hanson (2001).
[13] To simplify the analysis, it is assumed that majority of the manufacturing output is exported.

1 chooses to produce in the host economy, it requires A_1 unit of unskilled labor and D_1 units of skilled labor per unit of output. (a2)

- Properties of the revenue functions: the revenue function for domestic firm in industry i is $r^i(y_i, Y_i, \lambda_i(Y^d_1))$, where y_i is output of the domestic firm, Y_i is output of the rival foreign firm, Y^d_1 is domestic output of foreign firm 1, and the function $\lambda_i()$ captures productivity spillovers from foreign firm 1's domestic production to domestic industry i. As usual, the model assumes that $r^i_1 \geq 0$, $r^i_{11} \leq 0$, $r^i_2 \leq 0$, and $r^i_3 \geq 0$ (where subscripts indicate partial derivatives by order of argument in the revenue function). λ'_i may be positive or negative. Thus, revenue of a domestic firm is increasing in its own output, decreasing in the output of the foreign rival, and increasing (decreasing) in the domestic output of foreign firm 1 if that firm is a source of positive (negative) spillovers to the industry. Analogously, the revenue function for the rival foreign firm in industry i is $R^i(Y_i, y_i)$, where $R^i_1 \geq 0$, $R^i_{11} \leq 0$, and $R^i_2 \leq 0$. (a3)

The equilibrium is determined through factor-market clearing and profit maximization conditions. Factor-market clearing conditions require that supply equals demand in the market for unskilled labor,

$$l = x + \sum_i a_i y_i + A_1 Y_1 \qquad (1)$$

and in the market for skilled labor,

$$k = \sum_i y_i + D_1 Y_1 . \qquad (2)$$

Each domestic firm maximizes profit by choosing output, given the output of its rival foreign firm. First-order condition for domestic firm i is

(3) $$r_1^i - a_i - z = 0,$$

which is similar to the foreign competitor in the same industry. The model assumes that foreign firms are located abroad, except possibly for industry 1: if foreign firm 1 chooses to locate its production in the host economy, it's output choice is implicitly defined by the first-order condition,

(4) $$R_1^i - A_1 - D_1 z + s = 0$$

where s reflects a per unit subsidy that may be given to foreign firm 1 for producing in the host economy. Since pairs of domestic and foreign firms compete in a single world market, their profit-maximizing output choices can be expressed in terms of Cournot Best-Response Functions[14], $y_i=b_i(Y_i)$ and $Y_i=B_i(y_i)$.

The entry of a foreign firm raises the demand for labor in the host economy: the relative wage of skilled labor, z, rises because manufacturing is relatively intensive in the use of skilled labor. The rise in z increases the marginal costs for domestic firms, resulting in lower output and lower profits. This effect applies to *all* manufacturing firms. On the other hand, the production of foreign firm generates a productivity spillover for domestic firms. A positive spillover effect allows domestic firms to raise their output and earn higher profits. These two effects work in opposite directions, and hence, their impact on domestic firms' output and profits remains ambiguous. The third effect applies only to domestic firm 1, which competes directly with the foreign firm: the increased output of foreign firm 1 lowers the price for domestic firm 1's output, leading the domestic firm to reduce its output and thus, earn lower profits.

Next, Hanson considers the impact of a change in the unit production subsidy on welfare of the host economy. Since the model assumes that manufacturing firms produce for the world market, consumer surplus in the host economy need not be taken into account when examining the welfare effects of a subsidy to foreign firm 1. When final consumers of the output of the foreign firm 1 are assumed to be located abroad, the host economy welfare, W, is simply comprised of incomes to unskilled and skilled labor, profits to domestic firms and the subsidy to foreign firm 1:

$$W = l + zk + \sum_i [r^i - (a_i + z)y_i] - sY_1 . \tag{5}$$

Using the factor-market clearing condition for skilled labor in equation (2), the host economy welfare can be written as

$$W = l + zD_1Y_1 + \sum_i [r^i - a_i y_i] - sY_1 . \tag{6}$$

Hanson's analysis examines the impact of an increase in the production subsidy to foreign firm 1 on the host economy welfare, beginning from the base case with zero subsidy. Determining the welfare consequences of a subsidy to the multinational firm will also determine whether the social return to FDI exceeds the private return.

Totally differentiating equation (6) yields

$$dW = dzD_1Y_1 + zD_1dY_1 + \sum_i [r_1^{\,i} + r_2^{\,i} B_i' - a_i]dy_i + \sum r_3^i \lambda_i' dY_1 - dsY_1 , \tag{7}$$

---

[14] These functions are subject to standard conditions, $b_i' \le 0, B_i' \le 0$ and $b_i' > 1/B_i'$. By second-order conditions to profit maximization, Cournot stability conditions require that $r_{11}^i + r_{12}^i B_i' \le 0$ and $R_{11}^i + R_{12}^i B_i' \le 0$.

where the first two terms represent the change in factor income, which are positive if the subsidy induces foreign firm 1 to increase its output. The third and fourth terms in equation (7) represent the change in profits for domestic firms: the sign of the effect depends on the signs of the dy_i terms, the sign of productivity spillovers, and finally, in case spillover effect is positive, whether the rise in marginal costs or positive spillover effect is dominant. The fifth term equals the direct cost of the subsidy.

To facilitate the interpretation of equation (7), the expression is simplified by defining $\phi_i \equiv r^i{}_2 B_i' \geq 0$, which is the strategic effect of own changes in domestic output on domestic profits. Assuming that outputs are strategic substitutes, an increase in the output of a domestic firm induces a reduction in the output by its rival firm, which in turn raises profits of the domestic firm. Furthermore, the direct effect of the productivity spillover from foreign firm on domestic firms' profits is defined as $\beta_i \equiv r^i{}_3 \lambda_i'$. Using $r^i{}_1 - a_i = z$ from equation (3) and combining equation (2) and the first detailed assumption (a1) yields

$$(8) \qquad dk = 0 = \sum_i dy_i + D_1 \, dY_1 .$$

Due to the inelastic supply of skilled labor, an increase in output by foreign firm 1 leads to a net reduction in output by domestic firms, thereby leaving the total demand for skilled labor unchanged. Applying the definitions and equation (8) to equation (7), the welfare effects of the subsidy become more transparent in the following equation:

$$(9) \qquad dW = (dzD_1 - ds)Y_1 + \sum_i \phi_i dy_i + dY_1 \sum_i \beta_i .$$

The first term in equation (9) is the effect of the subsidy to foreign firm 1 on factor incomes, net of the direct subsidy cost. This term can be shown to be negative.

Intuitively, the foreign firm has chosen output to maximize profits in the initial state where the subsidy is zero. If it increases output, its profits, net of the subsidy, will fall. Therefore, in order to induce the foreign firm to raise its output the subsidy has to more than compensate the firm for the extra costs incurred from the expansion of output.

The second term of equation (9) is the strategic impact of the subsidy to foreign firm 1 on the profits of domestic firms. Excluding spillovers, the rise in factor costs would induce domestic firms to lower their output, which results in lower profits to domestic firms. Any firm that does not receive a positive spillover lowers its output, hence producing a negative value for $\phi_i dy_i$. Even those firms that do receive a positive spillover may lower their output in case that the effect of rising factor costs dominates. As can be seen from equation (8), the net change in output for domestic firms has to be negative for the foreign firm to raise its output. This leads to the prediction that only those domestic firms, which receive a substantial positive productivity spillover, will increase their output.

The third term in equation (9) represents the impact of the productivity spillover on domestic profits. This term is larger, the larger is the increase in output for foreign firm 1. But larger increases in foreign firm output tend to increase the demand for skilled labor, increasing the likelihood that the second term in equation (9) will be negative.

Following the analysis above it is possible to identify four conditions under which a subsidy to a multinational firm for producing in the host economy is likely to raise welfare of the host country:

- the factors used most intensively in production by the multinational firm are in elastic supply,
- the domestic firms that compete for resources with the multinational firm earn low to zero economic profits,

- multinational production generates large positive productivity spillovers for domestic firms in competing and non-competing industries,
- the gain in consumer surplus from increased competition in the domestic market is small.

The first condition guarantees that the impact of the subsidy on factor costs for domestic firms will be small, the second one guarantees that the welfare consequences from shifting production away from domestic firms and towards foreign firms will be small, and the third one is necessary for a subsidy to be worthwhile under any circumstances. The last condition goes beyond the simple analysis presented by Hanson: the model does not emphasize changes in consumer surplus, since if FDI does happen to raise domestic market competition then the optimal policy is not a subsidy to multinational firms but a generalized production subsidy to offset the distortionary consequences of imperfect competition.

4.4 Conclusions and other points of view

The models presented in the three previous sections model the behavior of MNCs and domestic firms in imperfectly competitive markets, taking into consideration the possibility of technology leakage or productivity spillovers from MNCs to domestic firms. The models by Das (1987) and Wang and Blomström (1992) examine productivity spillovers from MNCs to domestic firms within an industry, while the model by Rodríguez-Clare (1996) examines the effects of MNCs through linkages. Hanson's (2001) model includes both intra- and inter-industry spillovers. Next, the models describing intra-industry spillovers are compared with each other and some other points of view are discussed. A survey on the literature on linkages is presented by Glass et al. (1999), who also compare the model of Rodríguez-Clare (1996) to Markusen and Venables (1999) and Matouschek and Venables (1999).

Das (1987) models the optimal behavior of MNCs in the presence of technology leakages. The companies compete with *homogenous* products, MNC's subsidiary acting as a price leader, that is, having *monopoly* power in international markets. The decision problem of the MNC affiliate, the determination of the optimal price and output, is a *dynamic* one, since the domestic firms are able to increase their efficiency by learning from MNC's operation. On the other hand, domestic firms face a *static* decision problem, since learning is assumed to be *costless.* The technology transfer within the MNC leads to a decrease in optimal price over time and an increase in output and profits of MNCs, whereas the effect on output and profits of local firms remains ambiguous.

Wang and Blomström (1992) utilize a *duopoly* model with *differentiated* products. Differences in products affect the demand schedules of respective products: the price depends not only on quantity of both products but also on the relative attractiveness of the product, determined by technology differential between the firms. Contrary to Das (1987), Wang and Blomström assume the transfer of technology to be *costly* within the MNC. Furthermore, host country firms face an investment decision on how much resources to devote to learning although part of spillovers are assumed to be costless. Therefore, each firm chooses output to maximize its momentary profit, given the firms' technology levels and output of the competitors. *Intertemporally*, firms choose their technology investment to maximize their profit stream. In steady state equilibrium with constant prices and market shares MNC transfers some technology although local firms would be completely passive, as the technological lead of the MNC affiliate is eroded due to costless spillovers. The technology transfer improves the products of both foreign and domestic firms and firms earn profits over time.

Hanson (2001) models MNCs in *static* context, where firms compete with *homogenous* products. Firms choose output to maximize their profit in a standard *Cournot* competition framework. Firms in the domestic economy have price setting

power on world markets; if MNCs are assumed to be the only firms with price setting power, the market structure is similar to the one in Das (1987). Both technology transfer and learning are assumed *costless*. Contrary to previous models, Hanson considers the possibility of *negative spillovers*, as MNCs may lower the productivity in domestic firms, perhaps by driving them to less profitable market segments. Besides, Hanson acknowledges productivity spillovers *across industries*, thus connecting the model of Rodríguez-Clare (1996) to the ones by Das (1987) and Wang and Blomström (1992). The focus of Hanson's model is welfare effect of per unit production subsidy granted for the MNC: he concludes that subsidies to FDI would raise welfare of the host economy only under certain conditions.

All the models discussed above consider the behavior of MNCs and local firms when MNCs have already established a subsidiary and chosen to start the production in the respective market. Another strand of literature considers the choice between exporting and FDI in the presence of spillovers. For example, Glass and Saggi (1997) construct an oligopoly model, where the superior technology of a MNC is diffused to the host economy through labor mobility. In order to prevent the technology transfer, MNC can choose between producing elsewhere and serving the market through exports or paying a wage premium under FDI to keep its employees. If MNC decides to engage in FDI, it has to weigh the cost of paying higher wages against the benefit of limiting technology transfer to the host firms. The analysis shows that the choices made by the MNC commonly clash with the interest of the host country, which indicates a motive for FDI policy measures. FDI-inducing policies are found to improve host country's welfare. Moreover, wage premium paid by MNC increases welfare in the host country even if technology transfer does not occur. On the other hand, host country welfare can be improved by banning FDI in case MNCs are able to reap a significant cost reduction through FDI. If wages are high in an alternative production location, MNC would enjoy a substantial decline in its marginal cost when switching to FDI, thereby harming host country firms' profits. The analysis confirms that the loss in domestic firms' profits outweigh the effect of technology

transfer which contributes to lower costs for domestic firms or the effect of wage premium paid to curtail technology transfer.

Markusen and Ethier (1996) model the choice between exporting, licensing a foreign firm and establishing a subsidiary. The model includes all the aspects of OLI-framework, discussed in section 2.2. A source country firm has a temporary proprietary advantage in its new product (ownership advantage) and it has to decide how to exploit this advantage abroad. The locational and internalization aspects are covered through the firm's choice of exporting the good or the knowledge itself to a licensee or a subsidiary. The model assumes that host country firms eventually learn to produce the new good on their own and the learning process is speeded up if the good is produced in the host country rather than imported. With complete absence of protection for intellectual property in the host country, the foreign producer has to weigh costly exporting against the possible dissipation of its proprietary asset. Authors assume two subsequent periods and identify circumstances that lead to alternative supply arrangements.

Siotis (1999) adds to the modeling of spillover effects by considering the possibility that spillovers need not be unidirectional but instead, host country firms can be a source of positive externalities for MNCs. He identifies three cases: first, firms undertake FDI to source an advantage associated with the foreign location (*sourcing effect*); second, the existence of technology leakages reduces the profitability of a MNC that is technologically well ahead of host country competitors (*dissipation effect*); and third, spatially bounded spillovers enhance FDI when competitors enjoy similar productivity levels (*FDI enhancing effect*).

A simple base case considers two countries with similar costs. A foreign firm has to decide whether to serve the other market, 'host country', by establishing a subsidiary in that country or through exports. The strategy of the host country firm is restricted to exports. When firms possess similar capabilities positive spillovers increase the

relative profitability of FDI as opposed to serving the foreign markets through exports. FDI is mutually beneficial: although the firm-specific advantage of the MNC is dissipated, this loss is more than compensated by the positive effect of spillovers from the host country competitor. This example illustrates FDI enhancing effect. The dissipation effect occurs when the host country firm lags notably behind the foreign firm: the more advantageous firm may choose exports instead of FDI in order to avoid the diffusion of its firm-specific assets through spillovers. In the opposite case, when the foreign firm is less advantageous, a choice to engage in FDI is motivated by technology sourcing. This motivation is strengthened by the fact that spillovers are not limited to the subsidiary but can benefit the firm in its home market as well. (Siotis 1999)

The presence of spillovers links the two markets closely together through their effects on costs in both locations. Therefore, the model does not yield unique solutions when it is expanded to allow asymmetries between firms' technological capabilities and different costs across countries. The equilibrium outcomes depend on parametrization of the variables. (Siotis 1999)

All the models discussed in this chapter assume firm perspective and are concerned with the behavior of MNCs and local firms. Another option would be to consider spillovers in macroeconomic context. A strand of literature considers international technology diffusion and the effects of MNCs on economic growth of a country. For example Baldwin et al. (1999) construct a theoretical growth model where MNCs directly contribute to the endogenous growth rate of a country through technology spillovers. An empirical test using industry-level panel data from seven OECD countries supports the model. Most of the literature is empirical, showing mixed evidence of the effect of FDI on GDP growth or total factor productivity. Lichtenberg and van Pottelsberghe de la Potterie (1996) find no support that inward FDI flows would have carried knowledge spillovers among OECD countries during the period 1970-1990. The results by Borensztein et al. (1998) indicate that FDI is an important

vehicle for the transfer of technology, but only provided that the host country has a sufficient absorptive capability of advanced technologies. The study of Hejazi and Safarian (1999) supports the importance of FDI relative to trade as a channel for G6 R&D to the OECD countries. Finally, Xu (2000) distinguishes between technology diffusion effect and other productivity enhancing effects of U.S. MNC affiliates and finds further support for the results of Borensztein et al. (1998).

5 REVIEW OF EMPIRICAL EVIDENCE

This chapter reviews the empirical evidence of productivity spillovers, which were discussed at a conceptual level mainly in section 3.2.1 and then included in formal models in chapter 4. Evidence is also available on market access spillovers, described in section 3.2.2. Unfortunately, there is no prior empirical evidence about spillovers generated by MNCs in Finland, but findings of Vuori (1994 and 1997) on technology flows between Finnish manufacturing industries give some support to the existence of inter-industry spillovers in Finland.

5.1 MNCs as a source for spillovers - international research

Early literature is optimistic about the impact of MNCs on the productivity of host country firms. One of the earliest empirical assessments of the effects of FDI is the study by Caves (1974), who investigates the manufacturing sectors in Canada and Australia. While the results are insignificant for Canada, Caves finds that for Australian manufacturing sector the higher share of foreign subsidiaries coincides with higher productivity levels in competing domestic firms. More recent studies have also found a positive correlation between average industry productivity and the presence of foreign firms in the industry. Some of these studies are discussed below.

The productivity of Mexican manufacturing industry in the 1970s is examined by Blomström and Persson (1983). They use labor productivity as a measure for technical efficiency and relate it to capital intensity, labor quality and scale of production, whereas the degree of competition is measured by different concentration indices. The regression results confirm that the labor productivity in domestically owned plants is associated with the foreign presence in that industry. In a following study Blomström (1986) finds a similar relation between structural efficiency and foreign presence. The results indicate that it is the competitive pressure induced by MNCs' entry that promotes greater efficiency in domestic plants. He also concludes that MNCs' entry is related to structural changes only in modern sectors, which increases the dualism of the production structure in less developed countries.

Mexican manufacturing industry is further examined by Kokko (1994), who investigates the relationship between technology spillovers and the complexity of MNC technology. He finds that technology gaps do not preclude the realization of spillover effects, although the occurrence of spillovers is less likely in industries characterized by low technological competence.

The findings of Blomström and Sjöholm (1999), who examine Indonesian industries in 1991, are in accordance with the results from the Mexican studies. The study examines whether productivity levels differ in companies with minority or majority foreign ownership, and whether the degree of ownership affects spillovers. The results suggest that on average, the degree of foreign ownership has no impact on the productivity level either in foreign affiliates or in local firms.

To gain better understanding of technology leakages Mansfield and Romeo (1980) examine 26 technology transfers from U.S. based MNCs to their foreign subsidiaries. In most of the cases included in their study the technology became known to host country competitors within 6 years. Besides, technology transfer accelerated the

introduction of competing products or processes by at least two and a half years in about one third of the cases.

The above cited studies found foreign presence to have positive influence on the local firms in the industry. However, the causality of variables is far from clear since it is likely that MNCs are attracted to industries characterized by higher than average productivity levels. Hence, more recent studies have attempted to overcome this difficulty by using micro-level, time-series data on individual plants. This approach makes it possible to investigate how the productivity of domestic plants changes over time in response to the presence of MNCs. Haddad and Harrison (1993) examine Moroccan manufacturing sector in the 1980s and find no significant relationship between higher productivity growth in domestic firms and greater foreign presence in the sector.

Aitken and Harrison (1999) use panel data on Venezuelan plants for the period 1976-1989. Their results indicate that foreign presence actually *reduces* the productivity of domestic firms, whereas plants with foreign ownership seem to benefit from other foreign-owned firms. According to their interpretation the local firms gain from positive spillovers and are able to lower their average costs, but the adverse effect of product market crowding out outweighs the gains. As explained in section 3.2.1.2, foreign competitors with lower marginal costs draw demand from domestic firms, causing them to cut production. As a result, the productivity of domestic firms falls as the firms spread their fixed costs over a smaller market.

Girma et al. (1999) investigate the productivity and wage gaps between foreign-owned and domestic firms in the United Kingdom and whether the presence of foreign-owned companies raises the productivity in the domestic companies in the same industry. Their results from U.K. manufacturing sectors during the period 1991-1996 indicate that foreign-owned companies have higher productivity and they pay higher wages than domestic ones after controlling for the sectoral distribution and the

size of affiliates. The differential is approximately 5 % in terms of total factor productivity and wages once productivity differences are accounted for. The study finds no aggregate evidence of spillovers, although factors influencing the capacity of domestic firms to benefit from spillovers seem to affect the impact of MNCs on domestic firms' productivity. Firms with low productivity compared to the industry average gain less from foreign presence, similarly to firms in industries characterized by low skills and low levels of foreign competition.

Barry et al. (2001) study the effects of MNCs on domestic exporting and non-exporting manufacturing companies in Ireland using plant-level data for 1990 to 1998. The model assumes, consistently with the Irish evidence, that skilled labor is fully employed while unskilled labor is underemployed. The firms are divided into three groups: domestic exporters, domestic non-exporters and foreign-owned firms that tend to be totally export oriented. Barry et al. identify three channels through which MNCs affect the domestic firms' productivity: first, productivity spillovers, second, product market crowding out and third, labor market crowding out[15]. However, due to the differences in sectoral origins and export destinations there is little product market competition between foreign- and domestically owned firms. The labor market crowding out effect is restricted only to domestic exporters, since non-exporters are assumed to require unskilled labor only. The results by Barry et al. suggest that foreign presence in a sector has a negative effect on wages and productivity in domestic exporting firms while there are no effects on domestic non-exporters. This indicates that for domestic exporters negative labor market crowding out effect dominates any potential positive productivity spillovers. Moreover, there are no productivity spillovers for domestic non-exporters, which may lack the necessary absorptive capacity to benefit from spillovers since they do not face the same forces of international competition as exporters, use low levels of technology and have low innovative activities.

[15] See section 3.2.1 for more detailed explanations of productivity spillovers and effects of intensified competition.

The above described studies concentrate on examining productivity spillovers. There are also studies investigating market access spillovers, that is, whether MNCs improve the access of local firms to foreign markets. Aitken et al. (1997) study Mexican manufacturing plants in 1986-1990, the period following Mexican trade reform. They find that proximity to MNCs increases the probability that local manufacturing plant starts exporting, whereas general export activity does not correlate with the plant export propensity.

Rhee (1990) describes the success story of Bangladesh's garment exports. Initially, the country was lacking experience in international markets as well as technical, marketing and managerial know-how to produce and sell goods, and could not acquire these skills from abroad. The development process was started by a local catalyst with significant assistance from a foreign MNC. The foreign catalyst provided intensive on-the-job training, which resulted in employees learning not only production of world-quality exportable goods but also the entire operations of international company. The catalysts contributed also to policy environment, created access to imported inputs, which were preferred over local inputs due to their higher quality, reliability and efficiency, and provided import financing as well as marketing assistance. Technology and know-how diffused through labor mobility, resulting in tremendous growth of garments industry. Garments exports rose from USD 3,9 million in 1980-81 to USD 299,7 million in 1986-87, which represents average annual compounded growth of 106 %.

5.2 Spillovers in Finland

There are no studies about MNCs or inward FDI as a source for spillovers concerning Finland, at least to the knowledge of the author. However, the Research Institute of the Finnish Economy, ETLA, has carried out related studies, which have examined firms' R&D activities and indirect technology inputs as well as their effects on productivity developments in Finnish manufacturing companies. Although these

studies do not separate spillovers by origin, that is, whether they are sent by foreign- or domestically owned companies, they give support to the existence of inter-industry spillovers and try to estimate their importance on productivity of Finnish manufacturing industries.

Vuori (1994, 1-2) investigates both direct and indirect technology inputs and their effects on productivity developments in Finnish manufacturing industries in the 1980s. Direct technology inputs are defined as firms' own R&D activities, whereas indirect technology inputs include technology embodied in domestic and imported intermediate goods and machinery and equipment, and technological spillovers. Inter-industry spillovers are estimated by means of a weighted sum of R&D expenditures: the technology flow received by a certain industry is assumed to consist of the research expenditures of other industries, weighted by distance indicators. The distance indicators, which estimate the technological distance between industries, are calculated as the correlation of the distribution vectors of research expenditures across product groups. According to Vuori's estimates, the most important source industries for spillovers are radio, television and telecommunication equipment, other electrical equipment, pulp, paper and paper products, wood and wood products and metal products industry (ibid., 3).

Vuori (1994) performs regression analysis in order to examine the effects of direct and indirect technology inputs on total factor productivity growth and labor productivity growth in the 1980s. According to the results, spillovers seem to have a positive impact on firms' total factor productivity in the first half of the 1980s, whereas firms' own R&D efforts have a stronger impact in the latter half of the 1980s. However, the results are difficult to interpret due to interrelationships between variables. (ibid., 16)

In a subsequent study Vuori (1997, 7-9) proposes an alternative weighting scheme for estimating spillovers, in which the measure for the technological distance between

industries is based on the overlap of the research inputs. This measure takes better into account the number of links between industries and results in larger values for calculated spillovers. In this study Vuori estimates spillovers by means of two different weighting schemes on both R&D flows and stocks. Then she analyzes the relation between total factor productivity growth and technology inputs, both direct and indirect, defined similarly to her previous study. The regression analyses support the impact of firms' own R&D activities on total factor productivity growth. The analysis also indicates that spillovers from other industries have a positive effect on total factor productivity, although firm conclusions cannot be made due to interactions between variables. (ibid., 18)

6 FDI IN FINLAND

The objective of this chapter is to describe the progress of inward FDI in Finland from the industrialization period in the 19th century until the present day. The chapter begins with the discussion of scale and scope of inward FDI and motives for investing in Finland. The second section analyzes characteristics and performance of foreign-owned companies in comparison to domestically owned ones. The final section concludes the effects of foreign ownership on Finnish manufacturing industry and the implications on the hypothesis about spillover effects.

6.1 Development of Finnish inward FDI

Foreign firms have done few direct investments in Finland before the 1980s. Pajarinen and Ylä-Anttila (1998, 99) find several reasons for foreign investors' weak interest in Finland: small size of the market, unfamiliar language and culture, restrictions on foreign ownership, and protective attitude towards natural resources and key industries. However, FDI inflows started to increase in the 1980s and

continued to grow significantly in the 1990s. This increase can be explained in the first place by the global trend in FDI: Finland has received part of the global FDI growth, which has been substantial since the early 1980s. Second, Finnish companies have become more attractive as acquisition targets, since their technological and knowledge levels have increased. Third, the Finnish attitude towards foreign-owned companies has turned more positive: restrictions on foreign ownership were abolished in 1993 and the membership in the European Union has acted as a positive signal. (ibid., 99)

In the 19th century foreign firms invested in Finland mainly in order to sell their products, such as textiles and metals, to the Russian market. Establishing production units in Finland was profitable because Finland enjoyed lower customs duties to Russia before the independence. Foreign entrepreneurs, who brought expertise and new technology with them, played an important role in the early stages of Finland's industrialization during the latter half of the 19th century. The impact of foreign entrepreneurs was greatest on textile and sawmill industries, and in the new technological sectors such as electricity and chemistry. Generally foreign owners were independent entrepreneurs not backed by MNCs. In the course of time, the early factories founded by foreigners were often passed into Finnish possession. (Pajarinen & Ylä-Anttila 1998, 18-19)

In the early 20th century the importance of foreign-owned companies was even smaller than during the previous century. Nonetheless, foreigners contributed to the developing industries in which the Finnish knowledge was weaker, like electricity and electrical equipment industry. However, the Finnish attitude towards foreign ownership tightened up as a result of the globally tensing political atmosphere and the increasing interest in Finnish natural resources shown by foreigners. (Pajarinen & Ylä-Anttila 1998, 20) Consequently, a law on foreign ownership was passed in 1939, which remained in force as long as until 1993. Foreign ownership in Finnish companies was restricted to 20 % without a permission. In addition, foreign-owned

companies were required to get a permission in order to invest in real property. The law was enforced strictly until 1967, when Council of State expressed its support to inward FDI except in the forest and mining industries. The law was further mitigated by Council of State's decision in principle of 1989. (Heikkilä 1994, 12)

The law of 1939 was not the only restriction facing foreign investors. Bank of Finland exercised control over the financing of foreign-owned companies through foreign currency regulation. Since 1978 Bank of Finland favored equity financing and imposed restrictions on obtaining foreign credit. The foreign currency regulation was gradually abolished in the late 1980s; all kinds of long-term and short-term credit agreements between a foreign parent company and its Finnish subsidiary have been possible since 1991. Investments in certain industries remained still prohibited by restrictive trade practices. (Heikkilä 1994, 13)

The number of foreign-owned establishments started to increase since the 1960s, although the value of capital flows remained low. This resulted from the fact that majority of foreign-owned firms were sales and marketing companies requiring little capital. Foreign firms established in Finland in order to compete for the growing market and to take advantage of cheaper labor costs - at that time the Finnish labor was cheap at least when compared to Sweden. The firms seeking only cheaper labor left Finland quite rapidly in the late 1970s and the early 1980s as labor costs started to rise. Access to the Soviet Union market remained also as an important motive for FDI. (Pajarinen & Ylä-Anttila 1998, 21-23)

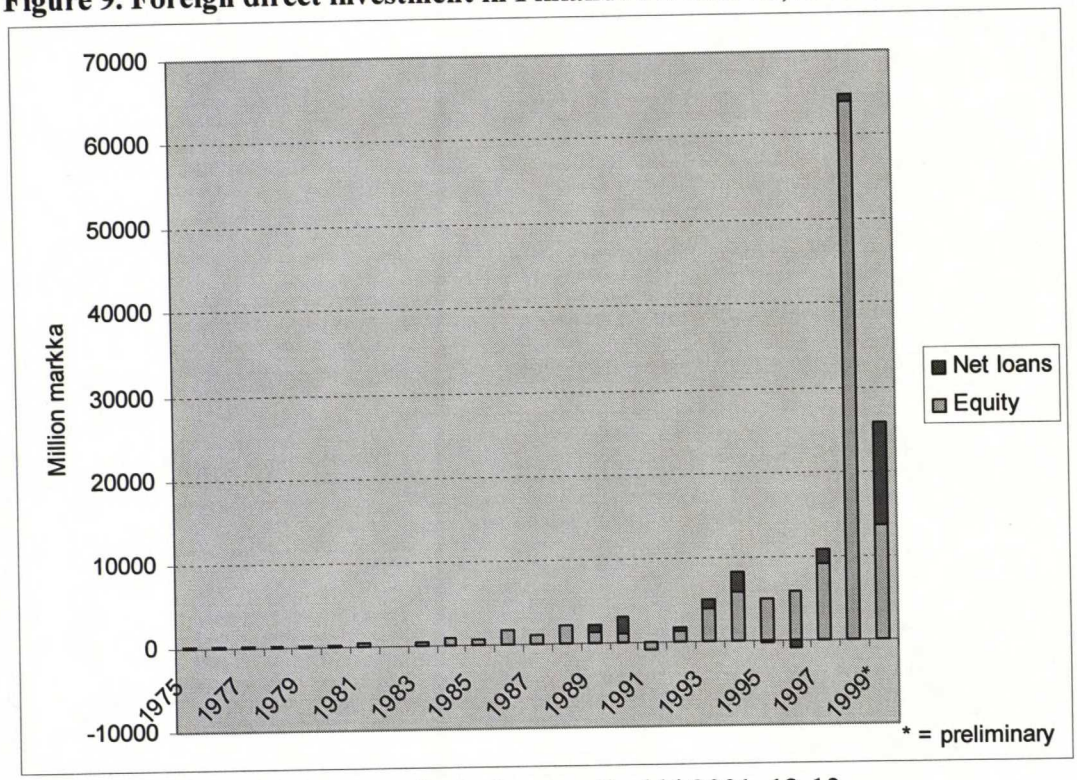
Net capital inflows started to increase gradually from the mid-1980s as a result of the abolishment of restrictions, the increasing number of interesting acquisition targets and the common trend of globally increasing FDI flows. During the 1990s the majority of foreign companies established in Finland by acquiring a national enterprise instead of a greenfield entry. According to Pajarinen and Ylä-Anttila (1998, 78) this indicates that the dominant motive of foreign companies has been to

exploit specialized knowledge of the acquired Finnish companies instead of exploiting their own ownership advantage in the Finnish market. Besides, FDI may have been motivated by the intention to increase market share by buying a competitor and then transferring the production activities somewhere else; however, these cases have been rare in Finland and concentrated in sectors characterized by a low technological knowledge level. Moreover, the number of potential targets for acquisition has increased, as Finnish companies have begun to concentrate on their core businesses and consequently sold units not compatible with the new strategy. (ibid., 78)

Despite of the recent growth of the inward FDI in Finland, there is still a clear imbalance between inward and outward FDI stocks: for example in 1997, the Finnish outward FDI stock was twice the size of the inward FDI stock. Also internationally compared the Finnish FDI has clear growth potential, as the ratio of inward FDI stock to GDP was the smallest among a sample of small and medium-sized European countries in 1997. (Pajarinen 1999, 6)

Figure 9 illustrates the rising trend of inward FDI flow. The net capital inflows have been positive during the whole examination period, except for the years 1982 and 1991. The exceptionally high figure for 1998, FIM 64,9 billion is explained by a large merger in the finance sector, namely the merger of Finnish Merita and Swedish Nordbanken, which resulted in a record high investment inflow to the finance and insurance sector. According to Bank of Finland (2000, 3) the main immediate investor countries at the end of 1999 were Sweden, the Netherlands and Denmark. The United States and the United Kingdom were also among the most significant investors during the 1990s (Suomen Pankki 1994-2000).

Figure 9. Foreign direct investment in Finland: net inflows, 1975-1999[16]

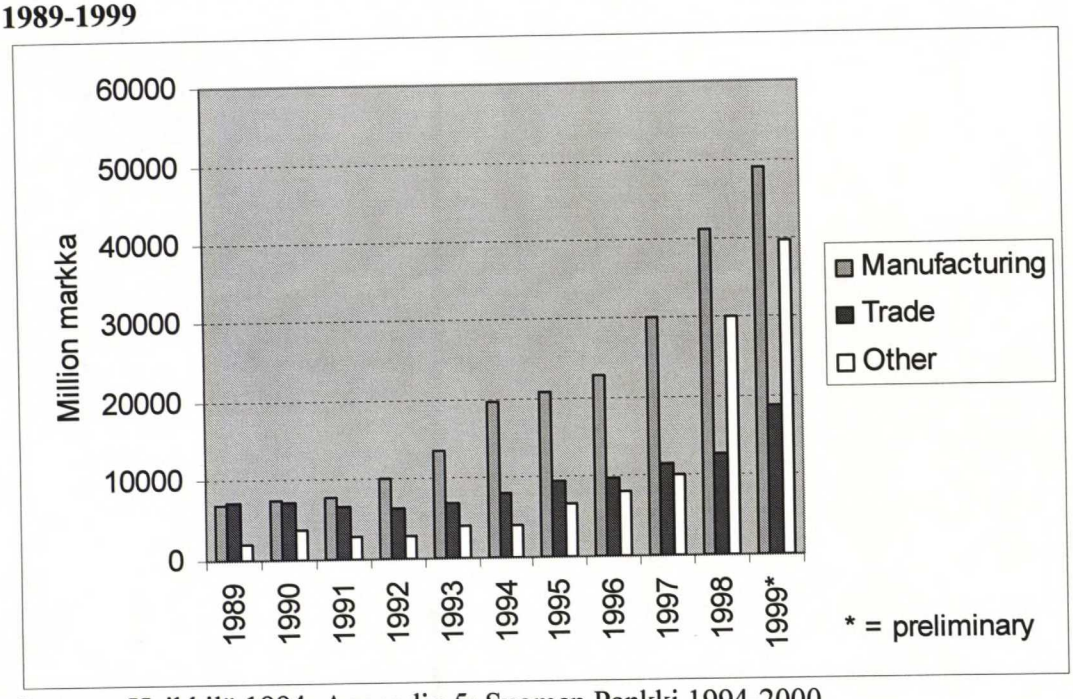


Sources: Heikkilä 1994, Appendix 2; Suomen Pankki 2001, 12-13

During the 1990s, investments in manufacturing sector particularly increased significantly: the investment stock in manufacturing became sevenfold in ten years. As shown by Figure 10, the importance of manufacturing has surpassed trade since the beginning of the 1990s. The share of trade has decreased further as a consequence of the increase in FDI stock in other sectors, particularly in finance and insurance. The effect of Merita-Nordbanken merger is again illustrated by the sharp increase in the investment stock in other sectors from 1997 to 1998.

[16] Reinvested profits are included in equity since 1981. Loans to the parent company are subtracted from net loans since 1991.

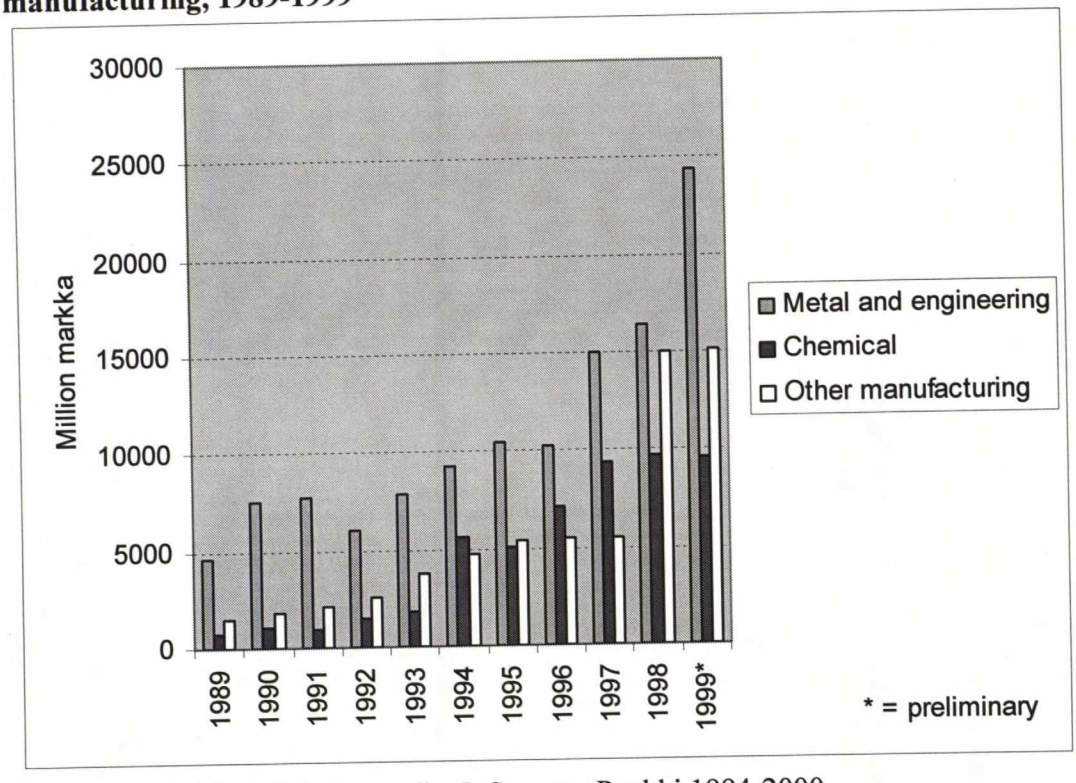
Figure 10. Foreign direct investment in Finland: stock of investment by sector, 1989-1999



Sources: Heikkilä 1994, Appendix 5; Suomen Pankki 1994-2000

FDI stock in manufacturing is examined in more detail in Figure 11. The majority of foreign investment has been received by metal and engineering sector, although its relative importance has declined substantially towards the end of the 1990s. FDI stock in chemical and other manufacturing sectors has increased sharply during 1989-1999: the FDI stock became twelve fold in chemical sector and tenfold in other manufacturing, whereas the investment stock in metal and engineering became only fivefold during the same period.

Figure 11. Foreign direct investment in Finland: stock of investment in manufacturing, 1989-1999



Sources: Heikkilä 1994, Appendix 5; Suomen Pankki 1994-2000

6.2 Characteristics of foreign-owned firms in Finland

The previous section described the growth of capital flows from abroad and the distribution of foreign-owned capital stock in different industries. The increasing importance of foreign-owned companies is also evident when foreign ownership is measured by the proportion of foreign-owned companies in the total sales of businesses or in the number of personnel. According to Statistics Finland (2001, 3), the share of net sales by foreign-owned companies increased from approximately 9 % in 1994 to over 14 % in 1998, and the share of employees increased from good 6 % to over 10 % during the same period.[17] Statistics Finland (2001, 4-6) report that foreign-

[17] Statistics Finland defines a company as foreign-owned if over 50 % of the vote is directly or indirectly in the control of a foreign owner, whereas Bank of Finland utilizes 10 % of the vote as a distinction between foreign and domestic ownership. Besides, the Structural Business Statistics include only independent

owned companies accounted for 13 % of employment in manufacturing, which corresponds to almost one half of the personnel of all foreign-owned companies in 1998. Within manufacturing, metal and chemical industries employ circa 80 % of all personnel of foreign-owned manufacturing companies.

Foreign ownership is concentrated in larger companies than average, both in terms of sales and personnel. The proportion of foreign-owned companies has risen relatively most in the largest size categories: while the proportion of foreign-owned companies in companies employing less than 10 persons has remained at only 0,2 % during 1994-1998, this proportion has increased to circa 20 % in companies with more than 100 employees. (Statistics Finland 2001, 7)

Pajarinen and Ylä-Anttila (1998) study the differences between foreign-owned[18] and Finnish-owned companies in 1990-1996. They find that foreign-owned companies are more profitable than domestically owned when measured by return on capital invested. Foreign firms also invest less in fixed assets, which contributes to higher return on capital. On the other hand, Finnish-owned firms seem to do better in terms of profit margins, and their labor productivity is higher in manufacturing sector. Domestically owned firms are more indebted when measured by debt to sales –ratio, whereas differences in equity ratios are insignificant. Although part of the differences can be due to the differences in sectoral distribution between foreign- and domestically owned firms, some of the differences persist in sectors like electricity and electric equipment. (ibid., 69-71)

On average, foreign firms have acquired technology intensive companies, where the average education level of employees is also higher. Thus it is not surprising that foreign-owned companies pay their employees, on average, slightly higher wages

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business enterprises liable to submit financial statements in Finland, thus the statistics do not cover business branches of foreign companies.

[18] Pajarinen and Ylä-Anttila (1998, 67) define a company foreign-owned when at least 50 % of votes are controlled by a foreign owner.

than domestically owned ones. Furthermore, foreign-owned firms have been found to be more export oriented and research intensive than Finnish-owned. These differences are again, at least partly, due to the differences in sectoral distribution. (Pajarinen & Ylä-Anttila 1998, 36-38)

When Pajarinen and Ylä-Anttila (1998, 72) extract manufacturing companies that were under foreign control during the whole examination period of 1990-1996, they find that foreign-owned companies experienced significantly higher growth in employment and value-added than Finnish-owned companies. Furthermore, the number of employees started to recover earlier after the deep recession of the early 1990s in foreign-owned firms, which can be due to the higher export orientation of these firms.

Pajarinen and Ylä-Anttila (1998) examine acquisitions in which an originally Finnish company was acquired by a foreign investor between 1990 and 1996. The sample covers a bit over 60 acquisitions, of which three-quarters were manufacturing companies. Generally the acquired companies were profitable both in terms of return on capital invested and profit margin before the acquisition; on the other hand, many of them had financial problems. After the change in ownership the acquired companies were usually able to improve their performance; financial stability improved, reduction in investment in fixed assets improved the return on capital invested and cuts in work force increased the labor productivity, as measured by value-added per employee. Moreover, foreign owners were usually able to acquire new customers, as exports rose clearly after the acquisition. (ibid., 80-83)

A study by Maliranta (1998a) on the importance of the technology generation, learning by doing and regional spillovers for the performance level of Finnish manufacturing plants notes that the total factor productivity[19] in foreign-owned

[19] Total factor productivity is defined as the part of output growth not accounted for by the increase in the use of inputs for production (capital or labor) or the substitution of these inputs. In other words, total factor

companies (foreign ownership at least 20 %) is circa 10 % higher than in domestically owned. In a subsequent study Maliranta (2000) investigates the role of R&D as a determinant of productivity growth in Finnish companies. He estimates two-year labor productivity growth using Cobb-Douglas function and finds that productivity growth is slightly faster in foreign-owned (the share of foreign owners at least 50 %) than in Finnish-owned companies for the periods 1990-1992, 1992-1994 and 1994-1996, holding other factors constant. The initial productivity level of the companies is found to be crucial for the significance of the estimation results. This study does not find any significant differences in productivity growth between foreign- and domestically owned companies by using a model explaining total factor productivity growth. (ibid., 65)

6.3 Conclusions: effects of FDI on Finnish manufacturing sector

Pajarinen and Ylä-Anttila (1998, 25) state that the importance of foreign-owned firms remained very modest on macroeconomic level until the end of 1980s. Nevertheless, in certain narrow sectors foreigners had a significant role, even monopolizing the market. In addition, there were single cases where foreign owner provided substantial assistance, such as marketing channels and technological know-how. However, the perhaps most important impact of foreign-owned companies was the model of how to succeed that they provided Finnish firms with.

The effects of FDI on the development of the Finnish economy have been mainly positive: foreign owners have been able to increase the efficiency and foreign sales of the acquired companies, as well as to improve their financial strength. On the other hand, some acquisitions, particularly in low technology industries, have led to closing down of the Finnish production facilities and moving production elsewhere. (Pajarinen & Ylä-Anttila 1998, 92-93) Pajarinen and Ylä-Anttila (1998, 109)

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productivity measures the increase of efficiency and technological change and the effects of improvement in the quality of inputs, management or organization of production. (Tilastokeskus 2000, 10)

acknowledge also the possibility of spillovers from foreign companies: by being more profitable and export intensive, foreign-owned companies reinforce competitiveness of the Finnish industry, and their effective use of capital provides Finnish manufacturers with a positive example. Additionally they recognize the importance of FDI as a channel for technology transfer, but since the knowledge level of Finnish firms is already quite high, the significance of FDI is likely to be smaller nowadays than it could have been earlier (ibid., 93).

Different motives for FDI affect the magnitude of expected spillovers.[20] Foreign companies established in Finland have clearly had two different types of motives. First, foreign companies have entered Finland in order to exploit their firm-specific assets, that is, their ownership advantage. (Pajarinen & Ylä-Anttila 1998, 101) These ownership advantages may result in productivity and market access spillovers in domestic companies, as discussed in chapter 3. Second, foreign firms have acquired knowledge intensive Finnish companies in order to improve group's global competitiveness (ibid., 102). These foreign-owned companies do not automatically generate spillovers, as the acquirer may in fact lack the characteristics that would give rise to spillovers.

7 EMPIRICAL ANALYSIS

The objective of this chapter is to analyze the effect of foreign-owned companies on productivity of the industry as a whole and, in particular, on productivity of domestically owned companies in that industry. To see if there are positive or negative spillovers resulting from the presence of foreign-owned companies, labor productivity of domestically owned companies is regressed on a number of variables, including foreign ownership in an industry. The chapter begins with defining the

objectives and hypotheses of the empirical analysis, and presenting the data set utilized. After a brief look on the structure of models applicable for panel data, two different equations for regression analysis are defined and estimation results are analyzed.

7.1 Objectives and hypotheses

The objective of the empirical part of this paper is to find out whether foreign ownership in an industry affects the domestically owned firms in the same industry. If there is a positive relation between the productivity level in the domestically owned companies and the foreign ownership in the same industry, *ceteris paribus*, FDI does raise the productivity of domestically owned companies through spillovers.

Taken into account previous studies, particularly those by Aitken and Harrison on Venezuela and by Haddad and Harrison on Morocco, negative spillovers can be expected as well as positive ones. Negative or insignificant spillovers are a possible result for the Finnish manufacturing companies since the Finnish companies already have a high knowledge level - on the other hand, a certain knowledge level is required for the realization of spillovers in the first place (see section 3.2.3). As discussed in the previous chapter, the entry of foreign firms in Finland has been only partly motivated by MNCs' ownership advantage. This fact increases the possibility that spillovers are very modest or insignificant.

This paper adapts two different approaches following studies by Aitken and Harrison (1999) and Blomström and Persson (1983). As in the study by Aitken and Harrison, the logarithm of output for an industry is regressed on industry-level inputs and foreign ownership in order to investigate the effect of foreign ownership on the productivity level of an *industry as a whole*. Since the data set of the present study differs from the one utilized by Aitken and Harrison for the separation of variables by

[20] See section 3.2.3 and the model by Siotis (1999) in section 4.4.

ownership, another model, modified from the study by Blomström and Persson, is presented in order to examine the effect of foreign ownership on the productivity of the *domestic part of an industry*. In this second specification the labor productivity in domestically owned companies is regressed on a set of variables, including foreign ownership in an industry. The objectives of the two models are summarized by the following hypotheses:

H1: Foreign ownership has a positive effect on the productivity of an industry as a whole. This can be due to the higher average productivity of foreign-owned companies as well as positive spillover effects, which result in increasing productivity of domestically owned companies in the same industry.

H2: Foreign ownership has a negative effect on the productivity of an industry as a whole. This can be caused by the lower average productivity of foreign-owned companies or negative spillover effects, which decrease the productivity of domestically owned companies in the same industry.

H3: Foreign-owned companies are an important source of positive spillover effects and consequently, they improve the productivity of domestically owned companies in the same industry. The spillovers may result through demonstration effects, training of labor or the pressure of increased competition.

H4: Foreign-owned companies induce only small positive spillovers that are outweighed by the negative effects of increased competition, as the foreign-owned companies draw demand from domestically owned companies or crowd domestically-owned firms out on the labor market. Consequently, the productivity of domestically owned companies falls.

The first model specification, introduced in section 7.4, examines the impact of foreign presence on the productivity of the industry as a whole, attempting to confirm either hypothesis H1 or H2. Hypotheses H3 and H4 are tested in section 7.5, which presents a model for the labor productivity of domestically owned companies.

7.2 Data description

The data set employed in this paper comes from a joint project of Statistics Finland and Helsinki School of Economics and Business Administration. The data is gathered at plant level in three major fields of economic activity: (1) mining and quarrying, (2) manufacturing and (3) electricity, gas and water. The plants are classified at a four-digit level according to the standard industrial classification (SIC) of 1979. The years covered include 1974 through 1994, with some exceptions in case of certain variables. The original data set includes 151 037 observations after discarding one unidentified establishment. Of the existing 90 individual four-digit industries, four industries have been discarded due to lack of information. Consequently, the number of observations in the original data set totals 150 934.

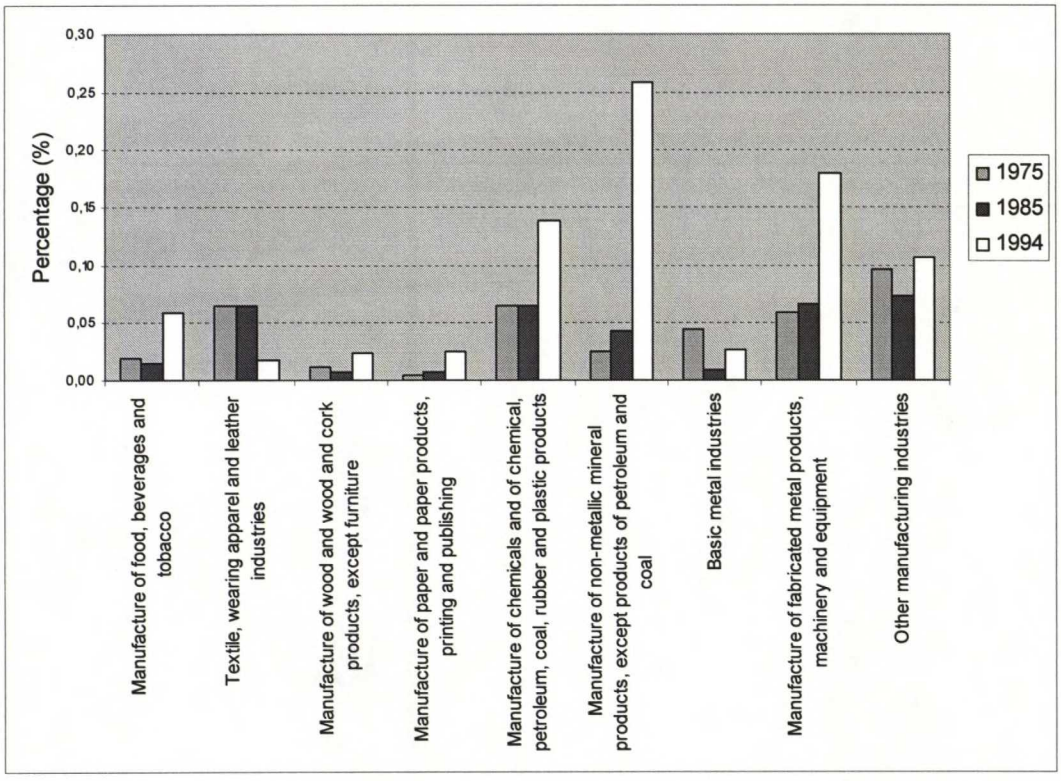
To maintain confidentiality, the released data set is aggregated at the four-digit SIC level. Year 1974 was discarded because of the lack of information on various variables. Of the three major fields of economic activity only manufacturing was selected for the study, again due to the lack of information. Thus the present study covers 78 four-digit industries during the period 1975-1994, that is 1 560 observations.

In the original data set a plant is defined as foreign-owned (hereafter referred to as 'foreign') if the plant belongs to a company with at least 20 % of shares foreign-owned. The rest of the plants, with foreign ownership less than 20 %, are defined as domestically owned (hereafter referred to as 'domestic'). The following variables are reported separately for domestic and foreign plants: number of plants, number of

employees and value-added. The other variables, not separated by ownership, describe characteristics of plants, their output and inputs, and industry structure. The fact that all the output and input variables are not separated for the domestic and foreign part of an industry complicates regression analysis and drawing the conclusions; however, separation cannot be done without access to the original plant level data.

Throughout this study, foreign ownership at industry level is measured as the proportion of foreign-owned companies in the total number of personnel in an industry. Figure 12 illustrates foreign ownership for years 1975, 1985 and 1994 by two-digit industry: foreign ownership has increased most significantly in metal and engineering, chemical and mineral products industries, whereas the foreign share has decreased in textile and basic metal industries. On average, foreign ownership has increased from 4,3 % to 9,3 % during the sample period (1975-1994).

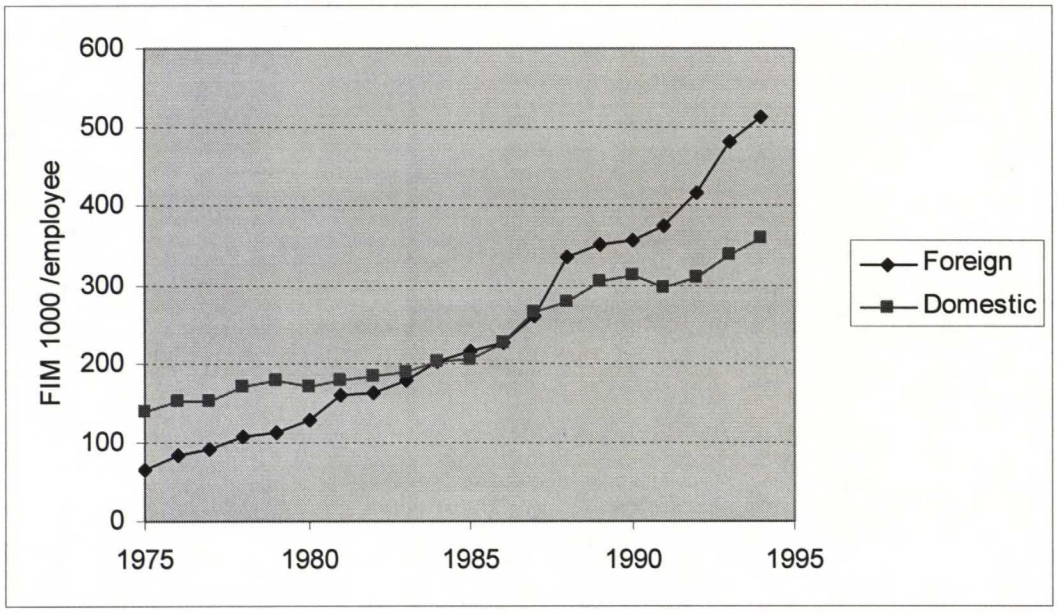
Figure 12. Foreign ownership as share of employment in an industry, 1975, 1985, 1994



Labor productivity, defined as value-added per employee, has increased on average 5,2 % yearly during the sample period in the whole manufacturing industry. The period includes years of high productivity growth, for example 1987 when average labor productivity increased by 17,4 %, and years when productivity has declined, such as 1980 and 1991 when labor productivity decreased by 3,8 % and 3,9 %. Figure 13 depicts the development of average productivity of manufacturing plants, separately for foreign and domestic plants. In the beginning of the sample period foreign plants were on average less productive than domestic ones, but since productivity in foreign-controlled part of the industry has grown steeper than in domestically controlled, foreign plants were able to catch up by the mid-1980s. On average, the productivity in domestic plants has increased at an annual rate of 5,2 %, whereas foreign plants have reached an annual growth rate of 11,7 %. The increase in the labor productivity of foreign plants reflects the rising number of acquisitions since the mid-1980s, motivated by foreign investors' growing interest in Finnish companies with high technology and knowledge level, and the turnaround efforts done by foreign owners (see section 6.2 for the discussion on the increase in productivity after a change in ownership).

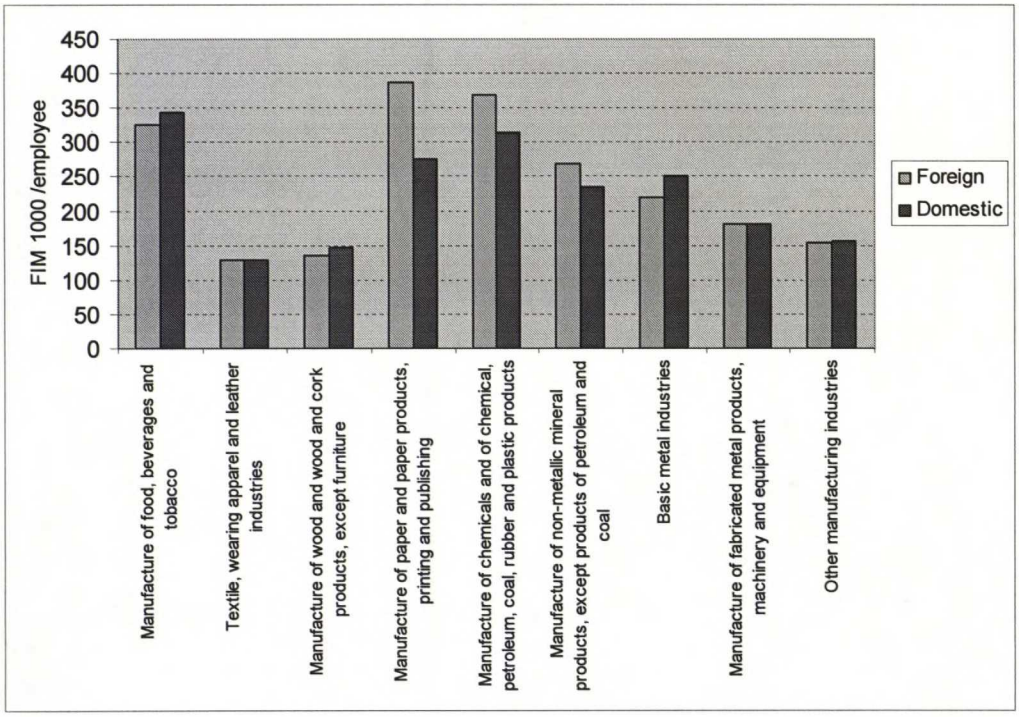
The lower average productivity in foreign plants during the first half of the sample period has to be taken into account then conceptualizing the possible outcomes of the estimations. As the foreign plants have lagged behind the domestic ones on average, it is probable that the impact of the foreign presence on the productivity in an industry, as measured for all plants in an industry, is negative during the early years of the period. Since the spillovers are measured in terms of labor productivity, it is also unlikely that domestic plants would benefit from the foreign presence during the beginning of the sample period. In the latter half of the sample period, foreign plants probably contribute to the productivity of an industry as a whole due to their higher than average labor productivity. Also, positive spillovers are more likely to occur in the second half of the examined period.

Figure 13. Labor productivity in foreign and domestic plants, 1975-1994



Labor productivity differs significantly across industries. Figure 14 compares the average labor productivity between foreign and domestic plants at two-digit industry level: during the whole sample period, foreign plants have been on average more productive in paper, chemical and mineral products industries.

Figure 14. Labor productivity of foreign and domestic plants by two-digit industry, average of 1975-1994



7.3 Models for panel data

The data set utilized in this study is comprised of cross-section and time-series data, which is generally referred to as a panel or a longitudinal survey.[21] In a panel data a given set of individuals is repeatedly sampled at different points in time. Thus, the data consists of multiple observations, denoted t = 1,…,Ti, on each of observation units, or 'groups', denoted as i = 1,...,N. The variables include

- dependent variable y(i,t)
- set of independent variables **x** = x1(i,t), x2(i,t), ..., xK(i,t) [22] and
- stratification indicator I(i,t),

[21] The description of panel data sets and regression models is based on Greene (1995), chapters 6 and 17.
[22] Bold print denotes a vector or a matrix.

where i=1,...,N stands for a group (N = number of groups), t = 1,...,Ti for a year (Ti = number of observations in group 'i') and K for the number of regressors. The stratification variable is an indicator that distinguishes the groups. Put into specific terms, the data set of the present study is constructed of 78 industries (i = 1,...,78), each of which is observed for 20 years (t = 1975,...,1994). The groups, or industries, are distinguished by the four-digit level SIC code. The data set constitutes a *balanced panel*, as each group covers the same number of years.

The structure of a regression model, so called 'effects' model, used for panel data is

$$y(i,t) = \alpha(i) + \gamma(t) + \beta'\mathbf{x}(i,t) + \varepsilon(i,t),$$

which captures variation across groups or time in simple shifts of the regression function, that is, changes in the intercepts. These models are the fixed effects and random effects models. The fixed effects model assumes a separate constant term, $\alpha(i)$, for each group, which is taken to be constant over time. The fixed effects model is applying to the cross-sectional units in the study, but not to additional ones outside of the sample. Thus, the fixed effect model is applicable when the sample of the study is (at least nearly) exhaustive. If sampled cross-sectional units are drawn from a large population, random effects model would be more appropriate, since it views the individual constant terms as randomly distributed across cross-sectional units. A fixed effect model is applied in the present paper, as the data set utilized includes all the manufacturing industries at the four-digit SIC level, except for three. Variations across time are taken into consideration by including time-dummies in estimations, that is, by applying a two-way fixed effects model, explained in further detail below.

The *one-way fixed effects model* is a classical regression model, which can be written as

$$y(i,t) = \mu(i) + \beta'\mathbf{x}\,(i,t) + \varepsilon(i,t)$$

where $\varepsilon(i,t)$ is a classical disturbance with

$$E[\varepsilon(i,t)] = 0 \text{ and } Var[\varepsilon(i,t)] = \sigma^2(\varepsilon).$$

One-way fixed effects model assumes a separate constant term for each group, $\mu(i)$. Thus, the model may be written as

$$\begin{aligned} y(i,t) &= \alpha 1\ d1(i,t) + \alpha 2\ d2(i,t) + \ldots + \beta' \mathbf{x}\ (i,t) + \varepsilon(i,t) \\ &= \alpha(i) + \beta' \mathbf{x}\ (i,t) + \varepsilon(i,t), \end{aligned}$$

where the $\alpha(i)$s are individual specific constants, and the d(j)s are group specific dummy variables which equal 1 only when j = i.

The panel data estimator also allows 'two-way' fixed and random effects models. The *two-factor fixed effects model* is written as

$$y(i,t) = \alpha 0 + \alpha(i) + \gamma(t) + \beta' \mathbf{x}\ (i,t) + \varepsilon(i,t).$$

Compared to one-way fixed effects model, two-way model has an overall constant term as well as a 'group' effect for each group and a 'time' effect for each period. By imposing the restriction

$$\Sigma(i=1,N)\ \alpha(i) = \Sigma(t=1,T)\ \gamma(t) = 0,$$

the problem of multicollinearity, that is, the time and group dummy variables both sum to one, can be avoided. Since the data set in the study is a balanced panel, the simple sums are zero.

7.4 Impact of FDI on productivity – industry-level examination

7.4.1 Model specification

Next, a log-linear production function is estimated in order to investigate the effect of foreign ownership on production level of an industry. The specification is modified from Aitken and Harrison (1999):

(1) $$Y_{it} = C + \boldsymbol{\beta}_1 \mathbf{X}_{it} + \beta_2 FDI_{it} + \varepsilon_{it}$$

The dependent variable, logarithmic output (Y) for industry i at time t is regressed on a vector of logarithmic inputs **X** and a measure of foreign ownership. Since the data on variables used in this model specification is not separated for foreign and domestic plants, it is difficult to draw conclusions about spillovers from the foreign presence. Nevertheless, estimating the model indicates the impact of foreign ownership on the industry as a whole. The estimated coefficients on inputs are expected to be positive, as an increase in the use of each input is expected to generate an increase in output (although the marginal increase is diminishing). The effect of foreign ownership on output can be interpreted as a pure total factor productivity gain or loss, since the differences in inputs are controlled for by the regression equation (Aitken & Harrison 1999, 609).

The output (Y) is defined as the value of manufacture, which includes compensation for repair and other industrial services and change in inventories but excludes sell of merchandise. Inputs include the number of blue-collar workers (LABORB), the number of white-collar workers (LABORW), the value of materials and other procurement (MAT), including also energy, services and rents for fixed assets, and the estimate for the capital stock (K), consisting of machinery and equipment, including transport equipment. The foreign ownership (FDI) is defined as the share of employees in an industry employed by foreign companies. Variables measured in

Finnish markka (FIM) are given in fixed prices, 1990 as the basic year for calculations.[23] The definitions of variables are summarized in the table below.

Table 3. Definitions of variables for equation 1

Dependent variable	
Y	Value of output produced, including value of manufacture, repair and other industrial services but excluding sell of merchandise, fixed price FIM 1000
Independent variables	
LABORB	Number of blue-collar workers
LABORW	Number of white-collar workers
MAT	Value of materials and other purchases, including energy, services and rents for fixed assets, fixed price FIM 1000
K	Estimated capital stock, fixed price FIM 1000
FDI	Share of employees in an industry employed by foreign companies, percent

Table 4 provides basic information of the variables used. Deviations across industries are quite significant, as can be seen in the second column, which reports standard deviations, and by comparing minimum and maximum values. Data on materials and other procurement is incomplete for the year 1985, which explains the minimum value of zero. Simple correlation coefficients for logarithmic variables are shown in Appendix 1.

[23] Materials and other procurement are deflated by a four-digit production price deflator. The index used is for the using, not for the supplying industry. Ideally, material price deflator would be calculated for each

Table 4. Descriptive statistics of variables for equation 1, 1975-1994

	Mean	Standard deviation	Minimum	Maximum
Y	3 106 780	5 073 450	8 486	48 661 600
LABORB	4 307	6 105	65	39 071
LABORW	1 478	2 084	11	14 320
MAT	2 043 130	3 634 510	0	31 424 900
K	725 595	2 159 240	280	25 916 100
FDI	0,07	0,11	0,00	0,74

Output, materials and capital stock are expressed in FIM 1000, labor as the number of blue-collar and white-collar employees and foreign ownership as share of employees in an industry employed by a foreign company. Number of observations: 1560

7.4.2 Statistical results

Table 5 reports the results for estimations of equation 1[24]. All estimations include a time-varying component, which detects economy wide variations. All reported standard deviations include corrections for groupwise heteroskedasticity. The first column reports the estimation results for the whole sample period 1975-1994: foreign ownership has a positive effect on the productivity of an industry, but the effect is insignificant. Other independent variables prove highly significant and positive, as expected. The number of employees and blue-collar workers in particular contributes most to the output produced, whereas capital and materials play a minor role.

Next, the sample is divided into two groups: the first group covers the first ten years of the data set from year 1975 through 1984, and the second group the latter period from year 1985 through 1994. Dividing the sample half-and-half seems appropriate when considering the development of foreign and domestic productivity levels: since the mid-1980s foreign plants have been on average more productive than domestic ones (see Figure 13 in section 7.2). The periods differ also in regulatory terms: the restrictions on foreign ownership were mitigated from the latter half of the 1980s onwards (see section 6.1).

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industry with the help of input-output matrices. However, this data was not available for the present study.

[24] Regressions are run by LIMDEP, product of Econometric Software, Inc.

Table 5. Impact of foreign ownership on productivity of an industry: regressing log output on inputs and foreign ownership

Variable	1975-1994		1975-1984		1985-1994	
Constant	5,0440	***	3,6729	***	6,0231	***
	(0,1621)		(0,1902)		(0,2281)	
LABORB	0,6504	***	0,2890	***	0,8072	***
	(0,0357)		(0,0384)		(0,0406)	
LABORW	0,2423	***	0,1617	***	0,0765	**
	(0,0299)		(0,0307)		(0,0376)	
MAT	0,0654	***	0,4723	***	0,0160	***
	(0,0069)		(0,0182)		(0,0053)	
K	0,1310	***	0,0517	***	0,1071	***
	(0,0171)		(0,0151)		(0,0227)	
FDI	0,0435		-0,2109	*	0,1850	***
	(0,0636)		(0,1103)		(0,0607)	
Adjusted R^2	0,9878		0,9969		0,9938	
F-test	1238,88	***	2711,99	***	1346,57	***
Number of industries	78		78		78	
Number of observations	1560		780		780	

All specifications include time dummies. All standard errors (denoted in parenthesis) are corrected for groupwise heteroskedasticity. The dependent variable (output) and the independent variables measuring inputs (labor, materials and other procurement and capital stock) are expressed in logarithms.

* significant at the 0,10 level

** significant at the 0,05 level

*** significant at the 0,01 level

Equation 1 is estimated separately for these two periods, and the results are reported in Table 5. The second column reports the results for the first period, for which the coefficient on FDI is negative and significant at the 0,10 level. That is, the larger the foreign ownership in an industry, the less output the companies are able to produce, given the inputs. Since the differences in input use are already controlled for in the model, the change in output reflects a total factor productivity loss. The point estimate –0,2109 suggests that an increase of foreign ownership in an industry from zero to ten percent leads to a 2,1 percentage-point decline in industry's productivity.

The relation between output and foreign presence in an industry is opposite in the second period, reported in the third column of Table 5: the coefficient on FDI turns positive and becomes significant at the 0,01 level. The results imply that an increase in foreign share of industry's employment from zero to ten percent increases the productivity in that industry by 1,9 percentage points.

The importance of different inputs differs also across periods. While the coefficients on all the inputs remain positive, the impact of materials and other purchases becomes highlighted in the first period. The number of blue-collar workers explains still much of the variance of the independent variable. In the second period, the number of blue-collar workers contributes again most to the output, whereas the magnitude and significance of the coefficient on white-collar workers decreases. It is interesting to note that FDI has a larger impact on output in an industry than the capital stock.

The differences between the results in the second and third column reflect the initial differences in productivity levels of foreign and domestic plants as well as the faster productivity growth in foreign plants. The effect of foreign ownership for all the plants in an industry is clearly positive in the second estimation period. However, no conclusions can be drawn about possible spillover effects since the data on output and inputs are not separated by ownership: the positive coefficient in the second period can be completely due to the higher average productivity of foreign firms. As a matter of fact, foreign companies might create negative spillovers affecting domestic firms, but this effect would be more than offset by higher average productivity of foreign firms. That is why the next section analyzes the labor productivity of domestic plants by means of another model specification.

7.5 Impact of FDI on productivity of domestic firms

7.5.1 Model specification

In order to investigate the spillovers from foreign plants to domestic ones another model, following Blomström and Persson (1983), is specified in this section. Instead of output, as in the logarithmic production function presented in the previous section, a productivity measure is chosen as a dependent variable. Ideally, the productivity would be measured as a ratio of net output to an index of total factor inputs, but this data is not available for the present study. Consequently, following many other studies (in addition to Blomström and Persson 1983, see for example Caves 1974 and Globerman 1979) a partial productivity measure is used instead, namely labor productivity. This measure is also available separately for domestic and foreign part of each industry, and thus it serves well the purposes of the study. Labor productivity is defined as the ratio of value-added in domestic plants to the number of employees in the same plants.

The equation to be estimated has the same structure as in the previous section:

$$(2) \qquad VL\_D_{it} = C + \boldsymbol{\beta}_1 \mathbf{X}_{it} + \beta_2 FDI_{it} + \varepsilon_{it}$$

The dependent variable, labor productivity (VL_D) is regressed on a vector of factors influencing value-added per employee (**X**) and the foreign ownership, again defined as the share of employees in an industry employed by foreign companies. The independent variables chosen for the present study are modified from Blomström and Persson's study due to differences in the data sets utilized.

The first factor influencing labor productivity is capital stock (K), defined again to include machinery and equipment. The relation between labor productivity and

capital is expected to be positive[25]. Unfortunately, estimates on the capital stock are not available for foreign and domestic plants separately in the data set. Yet, this should not cause major problems as the correlation between capital stock and foreign ownership is quite close to zero (see Appendix 2 for simple correlation matrix).

Labor productivity is assumed to differ because of differences in the quality of the labor force. Higher quality, for instance due to higher education level, would presumably increase the value-added per employee. The data set includes various variables on the characteristics of the labor force, such as average length of education, seniority in an industry and share of employees with master's or bachelor's degree. However, these variables are available only for years 1988-1994, and thus not applicable to estimations covering the whole sample period. Thereby labor quality (LQ) is measured as the ratio of white-collar workers to blue-collar workers in an industry. Again, this variable is for each industry as a whole, including both domestic and foreign firms. This causes some bias in estimates since labor quality, defined in this way, is presumably positively correlated with foreign presence in an industry: foreign firms tend to employ workers who have received education longer than average[26]. The correlation matrix in Appendix 2 confirms that the positive relation between these variables is present in the data set utilized.

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[25] An alternative measure, namely capital intensity (defined as the value of capital stock per employee), was also used in estimations. However, the estimations yielded negative values for the coefficient on capital intensity, a result that was not expected and aroused suspicion on the meaningfulness of the variable. The failure to extract the domestic part of the capital stock may have contributed to the result. Besides, Pohjola (1996, 78) notes that despite the increase in capital intensity the labor productivity has decreased in the Finnish economy. Finnish firms have invested excessively in capital despite of the very low marginal productivity of capital, motivated by regional policies and tax reasons, among other things (ibid., 116-118). Peisa (1994, 22-23) finds that the marginal productivity of capital has been even negative after 1973, indicating that with less investment, the Finnish economy would have been able to produce more output.

[26] Labor quality for domestic plants was estimated by running a regression $LQ\_D=a+bFDI+\varepsilon$ for each four-digit industry, and then defining the estimate for domestic labor quality as $a+\varepsilon$, that is, the sum of constant term and residual. Then this estimate was used as an alternative measure for labor quality in regression analysis. However, the results were almost identical and consequently they are not reported here.

Value-added per employee may differ in two industries not only because of differences in technical efficiency but also because of different market situation: the more concentrated an industry, the higher value-added per employee can be expected. According to Blomström and Persson (1983, 496), the concept of concentration is associated with three determinants of competition: the number of firms in an industry, the inequality of market shares and coalition potentials. They choose Herfindahl index as their concentration measure basing on a study by Vanlommel et al. (1977), which concludes it is the best individual concentration index to capture the above mentioned three factors. Accordingly, Herfindahl index is utilized in the present study to measure the concentration of an industry. The Herfindahl index is calculated as

$$HERF=\sum_{i=1}^{n}\left(\frac{x_i}{X}\right)^2$$

where x_i represents the employment of the n individual plants and X represents the total employment of the industry. The larger the index value, the more concentrated the industry is. Consequently, the relation between Herfindahl index and the value-added per employee is expected to be positive.

Economies of scale are also likely to influence labor productivity, so another independent variable is constructed to control for this effect. Blomström and Persson (1983, 496) refer to various studies that have constructed indirect measures for scale economies in the absence of specific engineering data. Those studies assume J-shaped production cost curves over a significant range of output levels beyond minimum efficient scale (MES). Thereby, the presence of scale economies could be approximated by comparing the average gross production in domestic plants in an industry with the MES plant of the corresponding industry. The average size of the larger plants that account for 50 % of an industry's output is generally used as a proxy for a MES plant. The data set utilized includes an applicable variable for a MES plant, defined as the average size (in terms of value-added) of plants, the value-

added of which exceeds the medium of that industry. Thereby the scale variable (SCALE) is calculated as the ratio of average value-added in domestic plants in an industry to the estimated MES plant. The expected relation between scale economies and value-added per employee is positive.

Ideally, the dependent variable would be expressed as per hour productivity in order to avoid the impact of systematic differences in overtime, strikes, holidays, et cetera on value-added per employee. Thus, the average number of hours per employee in an industry (AH) is included in estimations. The number of hours is again for the industry as a whole, but there is no reason to expect the variable to vary according to ownership. The variable is constructed of the *effective* hours during each year, so it should be able to correct the possible effect of systematic differences in working time. The relation between working hours and labor productivity is not clear *ex ante*. On one hand, longer workdays may decrease productivity if tasks carried out require physical work contribution; on the other hand, longer workdays may increase labor productivity particularly for tasks requiring accumulation of human capital through experience and efficient and close teamwork (Maliranta 1998b, 22). All the variables for the second model specification are summarized in the following table.

Table 6. Definitions of variables for equation 2

Dependent variable	
VL_D	Labor productivity in domestic firms of an industry, ratio of value-added to number of employess, fixed price FIM 10
Independent variables	
K	Estimated capital stock, fixed price FIM 0,001
LQ	Labor quality, ratio of white-collar to blue-collar workers
HERF	Concentration measure, Herfindahl index
SCALE	Economies of scale measure, ratio of the average value-added in domestic plants of an indutry to MES plant of that industry
AH	Average hours worked by an employee, 1000 h
FDI	Share of employees in an industry employed by foreign companies, percent

All the variables measured in Finnish markka are given in fixed prices, 1990 as the basic year for calculations. In addition, they are scaled for convenience, so that labor productivity is expressed as FIM 10 per employee and capital stock as FIM 0,001. Table 7 presents means and standard deviations as well as minimum and maximum values for the variables used in the estimations of this section. Correlations between variables are presented in Appendix 2.

Table 7. Descriptive statistics of variables for equation 2, 1975-1994

	Mean	Standard deviation	Minimum	Maximum
VL_D	2,3040	1,6826	0,4347	17,6584
K	0,7256	2,1592	0,0003	25,9161
LQ	0,3902	0,2565	0,0924	2,9527
HERF	0,1309	0,1343	0,0049	0,8940
SCALE	0,5291	0,0724	0,0808	1,0000
AH	1,6933	0,0840	1,2537	2,1035
FDI	0,07	0,11	0,00	0,74

Domestic labor productivity expressed as FIM 10 per employee, capital stock as FIM 0,001, labor quality as ratio of white-collar to blue-collar workers, annual average hours worked per employee as 1000 h, foreign ownership as share of employees in industry employed by foreign company. Number of observations: 1560.

7.5.2 Statistical results

The first column of Table 8 reports the results for the estimation of equation 2, the sample covering the whole period of 1975-1994. The coefficients on both capital stock and labor quality are positive, as expected, although only the coefficient on capital stock is statistically significant, at the 0,01 level. The coefficient on concentration level, measured by Herfindahl index, is incorrectly signed and significant at the 0,10 level. The effect of average hours worked is not significantly different from zero.

Most of the variance of the dependent variable seems to be explained by the scale variable, measuring economies of scale in domestic plants. The coefficient is positive

and significant at the 0,05 level. The impact of foreign ownership in an industry is negative, large in magnitude and significant at the 0,05 level. The point estimate suggests that increasing foreign ownership from zero to ten percent in an average industry would lead to a decrease in labor productivity by approximately FIM 1,0 per employee or by 4,4 %.

Table 8. Impact of foreign ownership on labor productivity: regressing value-added per employee on various determinants and foreign ownership

Variable	1975-1994		1975-1984		1985-1994	
Constant	1,4690	*	1,9232	***	1,0777	
	(0,8190)		(0,5812)		(1,2269)	
K	0,1983	***	0,0880	**	0,0820	
	(0,0385)		(0,0403)		(0,0852)	
LQ	0,3399		0,5833	**	-0,2488	
	(0,2121)		(0,2525)		(0,2882)	
HERF	-0,9494	*	-0,4821		-0,9660	
	(0,5160)		(0,4328)		(0,9409)	
SCALE	1,3125	**	-0,7102	*	2,4262	***
	(0,5382)		(0,4189)		(0,7316)	
AH	0,0334		0,0391		0,4043	
	(0,4628)		(0,3165)		(0,6969)	
FDI	-1,0092	**	-1,5430	***	0,3206	
	(0,4087)		(0,4741)		(0,5319)	
Adjusted R^2	0,7466		0,8739		0,8161	
F-test	45,60	***	59,02	***	38,17	***
Number of industries	78		78		78	
Number of observations	1560		780		780	

All specifications include time dummies. All standard errors (denoted in parenthesis) are corrected for groupwise heteroskedasticity. The dependent variable (domestic labor productivity) is expressed as FIM 10 per employee, and the following independent variables are scaled for convenience: capital stock (FIM 0,001) and annual average hours worked per employee (1000 h).
* significant at the 0,10 level
** significant at the 0,05 level
*** significant at the 0,01 level

Next, the sample is again divided half-and-half (see section 7.4.2 for rationale). The second column of Table 8 reports the results for the estimation of equation 2 in the first period, 1975-1985, and the third column in the latter period, 1985-1994. The results for the first period are very similar to the results for the whole period (as reported in the first column): all the coefficients are similarly signed, except for the scale variable, which turns unexpectedly negative, remaining still significant at the 0,10 level. The impact of capital stock on labor productivity decreases in magnitude, while the importance of labor quality increases; both the variables are significant at the 0,05 level. Neither the concentration level nor the average hours worked contribute significantly to the value-added per employee.

The unexpected negative sign of the scale variable in the period of 1975-1984 raises questions: possibly the variable is not able to measure economies of scale correctly. Another possibility is that Finnish plants are not able to capture the benefits from economies of scale, and larger plants experience in fact *decreasing* returns to scale. In theory, decreasing returns to scale do not occur, as it would always be possible to replicate a production facility instead to increasing its size (Burda & Wyplosz 1997, 108-109). However, Pohjola (1996, 71) notes that Finnish firms have used their resources ineffectively throughout the period of 1973-1989: based on different growth contributors the Finnish economy should have grown 0,34 percentage points faster than the European average, while the actual growth rate was in fact 0,25 percentage points below the average. The ineffective use of resources is true for all industries, also most of the sectors within manufacturing. While the growth rate of capital intensity has increased, the growth rate of labor productivity has actually slowed down. (ibid., 77-78) This can be a consequence of the inelastic production technology: when the marginal rate of substitution between labor and capital is very low, the labor productivity stops increasing although capital intensity would increase to infinity. Low elasticity of substitution may also result from various imperfections such as imperfect competition, taxes and tariffs. (ibid., 116-118)

In sum, Finnish firms have invested excessively in capital although its marginal productivity has been very low or even negative. For example Peisa (1994, 22-23) finds that marginal productivity of capital in Finland has been lower than usually expected, and during the period 1973-1991 it has been even negative. The excessive investment has been motivated by the low real rate of interest, tax treatment of depreciation items and regional policy (Pohjola 1996, 113-116). Thus it seems possible that Finnish companies have had other incentives to increase in size than economies of scale.

The estimation results imply that foreign presence in an industry has created large negative spillovers in the first half of the sample period. The point estimate of foreign ownership increases in magnitude when compared to the period as a whole, and becomes significant at the 0,01 level.

When comparing the first period to the latter one, the results differ notably. Although the model itself remains statistically significant according to the F-test, the only coefficient that differs significantly from zero is the scale variable, which is again correctly signed. Economies of scale seem to explain most of the variance of the value-added per employee. The impact of labor quality turns negative, although the coefficient is statistically insignificant. The most interesting change occurs in the foreign ownership variable: the coefficient is positive although not significantly different from zero.

The change in the sign of the scale variable may indicate improvement in the efficiency of Finnish companies. As noticed by Statistics Finland (2000, 6), there has been a change from extensive to intensive growth after the recession in the beginning of the 1990s. In other words, the importance of the growth rate of physical capital as a determinant of economic growth has decreased in favor of the importance of the growth rate of total factor productivity.

The comparison of the two estimation periods suggests a change in the effect of foreign presence in an industry. In the first period, 1975-1984, there seems to be negative spillovers from foreign plants whereas in the second period, 1985-1994, the spillover effect is insignificant. This is not surprising when taking into account the fact that on average, foreign plants were more productive than domestic ones only since the mid-1980s. Consequently, positive spillovers would be less likely to occur in the first period. That the foreign presence decreased the value-added per employee in domestic plants during the first period suggest that foreign firms increased competition and were able to capture market share from domestic plants.

The results obtained from the estimations for the two periods encourage further investigation of the significance of foreign ownership. This time the sample period is divided into three periods, following the development of labor productivity in domestic and foreign plants. In the first period, covering years 1975 through 1980, foreign plants lag behind domestic ones in terms of average labor productivity; in the second period, 1981 through 1987, the productivity in foreign and domestic plants is approximately the same, and in the third period, 1988 through 1994, foreign plants are on average clearly more productive than domestic ones. Next, three dummy variables are constructed for the chosen periods, so that the first dummy equals one when the observation is from the first period (1975-1980), otherwise it equals zero. The two other dummy variables are constructed in a similar way for the second (1981-1987) and the third period (1988-1994). Next, the period dummies are interacted with foreign ownership variable (FDI) to obtain the following variables:

- FDI75_80 (= FDI, when t=1975,...,1980; = 0 otherwise)
- FDI81_87 (= FDI, when t=1981,...,1987; = 0 otherwise)
- FDI88_94 (= FDI, when t=1988,...,1994; = 0 otherwise)

Equation 2 is then re-estimated with addition of these new independent variables, one or two at a time. Of the different combinations of the above defined interaction terms included in estimations, two are reported in Table 9 (see Appendix 3 for the other

combinations). The coefficients on the independent variables utilized already in the previous estimations have not changed sognificantly. Most of the variance of the dependent variable is explained by economies of scale, which have positive and at the 0,05 level significant impact on labor productivity. Capital stock contributes also significantly to the labor productivity, while the effect of labor quality is insignificant. Both the concentration level and average hours worked have negative effect on labor productivity, although the coefficient on average workday is insignificant and the coefficient on Herfindahl index is significant only at the 0,10 level.

The results for estimating equation 2 with the addition of independent variables FDI75_80 and FDI81_87 are reported in the first column of Table 9. The coefficient on foreign ownership, for the period as a whole, is negative but insignificantly different from zero. By contrast, the coefficients on foreign ownership in periods 1975-1980 and 1981-1987 are significant at the 0,01 level, negative and large in magnitude. The results suggest that the negative impact of foreign ownership on the productivity of domestic plants results from the two earlier periods and that the later positive effects average the effect to zero.

The results shown in column 1 of Table 9 are given further support by the following estimation. Column 2 shows the results for estimating equation 2 when supplemented with the independent variable FDI88_94. The coefficient on foreign ownership, for the period as a whole, is again negative, whereas the coefficient on foreign ownership in period 1988-1994 is positive. Both the coefficients are significant at the 0,01 level and large in magnitude. Comparing the magnitudes of the coefficients, it can be noticed that they cancel out each other; that is, the negative effect of foreign plants on the productivity of domestic plants during the two earlier periods, 1975-1987, is almost totally offset by the positive spillovers during the last period, 1988-1994.

Table 9. Impact of foreign ownership on labor productivity: analyzing the significance of foreign ownership on value-added per employee in three time periods

Variable	1		2	
Constant	1,9222	**	1,8869	**
	(0,8140)		(0,8162)	
K	0,2150	***	0,2106	***
	(0,0381)		(0,0382)	
LQ	0,0838		0,1543	
	(0,2142)		(0,2135)	
HERF	-0,9607	*	-0,9842	*
	(0,5103)		(0,5117)	
SCALE	1,1927	**	1,2948	**
	(0,5333)		(0,5337)	
AH	-0,1220		-0,1457	
	(0,4590)		(0,4602)	
FDI	-0,1775		-2,5924	***
	(0,4362)		(0,5108)	
FDI75_80	-3,3679	***		
	(0,5694)			
FDI81_87	-1,6499	***		
	(0,5394)			
FDI88_94			2,4216	***
			(0,4757)	
Adjusted R^2	0,75225		0,7509	
F-test	46,08	***	46,18	***
Number of industries	78		78	
Number of observations	1560		1560	

All specifications include time dummies. All standard errors (denoted in parenthesis) are corrected for groupwise heteroskedasticity.
* significant at the 0,10 level
** significant at the 0,05 level
*** significant at the 0,01 level

These results should be treated with caution: because of the aggregation of the data, it is not possible to confirm a firm causality between foreign ownership and

productivity of domestic plants. It is possible that foreign-owned firms have gravitated towards more productive industries, which is reflected as higher than average labor productivity in domestic plants. The phenomenon observable in the last period of the data set, that domestic plants seem to benefit from the foreign presence in that industry, may be explained by the mitigation of restrictions faced by foreign owners: as the restrictions have been mitigated and finally abolished, foreign investors have been able to acquire plants in industries they are really interested in. Also, the overall improvement in technical capabilities and knowledge level of domestic firms may be reflected in the results. Therefore, to reach firmer conclusions the study should be repeated with the original data set, that is, with plant-level data.

8 SUMMARY AND CONCLUSIONS

The objective of this paper is to examine spillovers from inward FDI, both in theory and in practice. The question of the existence of spillovers is relevant as many governments in developed and developing countries have started to attract FDI by offering substantial incentives from public funds. Finland is no exception, although the scale of subsidies has been so far modest compared to the United Kingdom and Ireland, for example. Subsidies to FDI are justified only under certain circumstances, as shown by a model developed by Hanson (2001), described in section 4.3.

The theoretical analysis starts with a brief review of international trade theory and factors giving rise to multinational production. According to the OLI-framework developed by Dunning (1981), firms undertake direct investment in order to exploit their ownership advantage, in addition to which the host market should provide location advantages, while internalization advantages induce firms to exploit their ownership advantage within a firm rather than through arm's length transactions. Ownership advantage usually results from intangible assets, also referred to as

knowledge capital, which can yield services in many locations without reducing their productivity in others. A formal model on the welfare effects of MNCs (in the absence of spillovers) by Markusen and Venables (1995) is described in the final section of chapter 2.

The joint character of knowledge capital makes it a possible source for externalities, spillovers. The spillover concept is discussed in chapter 3, after a brief introduction to the direct effects of FDI. Spillovers are categorized in the first place into productivity and market access spillovers, and second, into intra-industry and inter-industry spillovers. Intra-industry spillovers increase the productivity of domestic firms in the same industry through demonstration effects, competition and training of labor. Inter-industry spillovers refer to backward and forward linkages that result from MNCs' contacts with their suppliers and customers. The possibility of negative effects is also taken into account, as MNCs may crowd domestic firms out on product and/or labor markets or generate a negative linkage effect by creating less linkages with upstream industries than domestic firms would do.

Chapter 4 pays attention to welfare of the host economy in the presence of MNCs and spillovers. The models by Das (1987) and Wang and Blomström (1992) describe the behavior of MNCs and domestic firms in imperfectly competitive markets, assuming technology leakage or productivity spillovers within an industry, whereas the model by Rodríguez-Clare (1996) examines the effects of MNCs through linkages. Hanson's (2001) model on FDI promotion includes both intra- and inter-industry spillovers and acknowledges negative effects as well. The chapter ends with the consideration of alternative viewpoints in modeling spillovers.

As reminded by Hanson (2001), substantial positive spillovers from FDI are the only legitimate justification for FDI promotion. However, the empirical evidence of spillovers from MNCs (chapter 5) is mixed. While most of the early studies have evidenced positive spillover effects, specifically in developed countries, the more

recent studies using firm-level data for various years have found MNCs' impact on productivity of domestic firms to be insignificant or even negative.

Chapter 6 provides background for the empirical part of this paper by presenting the development of inward FDI in Finland. The chapter points out that Finnish inward FDI has remained very modest until the 1980s. The global trend in FDI, the improved attractiveness of Finnish companies as acquisition targets and the deregulation have all contributed to the increase in the inward FDI since the 1980s. The chapter describes the characteristics of foreign-owned companies in Finland, but there is lack of research on the effects of MNCs on the rest of the Finnish economy.

This paper adds to the empirical research by providing evidence of the effects of foreign-owned companies on productivity of Finnish manufacturing industries and of domestic firms in particular. The analysis is performed using four-digit industry data, originally gathered at plant level by Statistics Finland. The period analyzed covers years through 1975 to 1994.

In the first model specification, following Aitken and Harrison (1999), the logarithm of output for an industry is regressed on industry-level inputs and foreign ownership in order to investigate the effect of foreign ownership on the productivity level in an *industry as a whole*. The effect of foreign presence is insignificant for the whole period, while the results differ for the first and last ten years. For the period of 1975-1984 the coefficient on FDI is negative, and for the period 1985-1994 the coefficient on FDI becomes positive.

The second model specification, adapted from Blomström and Persson (1983), regresses labor productivity on a vector of factors influencing value-added per employee and foreign ownership. When estimated for the whole sample period, the impact of foreign ownership in an industry is negative and large in magnitude. When the sample is divided half-and-half, the results imply a change in the effect of foreign

presence on productivity of domestic plants. In the first period, 1975-1984, there seems to be negative spillovers from foreign plants whereas in the second period, 1985-1994, spillover effect is not significantly different from zero. The significance of foreign ownership is further examined by constructing three period dummies and interacting these with foreign ownership variable. The results imply that the negative impact of foreign ownership on the productivity of domestic plants results from the earlier years of the estimation period, and that later positive effects following the mitigation of restrictions average the effect to zero.

The results for the earlier period are not surprising taking into account that on average, foreign plants were more productive than domestic ones only since the mid-1980s. Consequently, positive spillovers would be less likely to occur in the first period of ten years. Moreover, as noted in chapter 6, foreign investors have established in Finland not only to exploit their ownership advantages but also to take advantage of high technology and knowledge level of Finnish firms, which may affect the spillover potential of foreign-owned firms.

The results obtained should be treated with care. The aggregation of the data on four-digit SIC level makes it possible that positive effects observed during the last years of the sample period may actually reflect the impact of deregulation: foreign investors have gravitated towards more productive industries previously not accessible to them. Therefore, in order to draw more reliable conclusions the study should be repeated with plant-level data. As the period for which restrictions have been abolished is so short in the present data set, it would be worthwhile to repeat the estimations on data covering more recent years. With plant-level data it would be also possible to investigate whether MNCs from certain countries generate more spillovers than others. Another subject for further research would be estimation of inter-industry spillovers.

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Appendix 1

Correlation matrix for variables used for estimating the impact of FDI on productivity of all plants in an industry

	Y	LABORB	LABORW	MAT	K	FDI
Y	1,00000					
LABORB	0,85991	1,00000				
LABORW	0,90525	0,92886	1,00000			
MAT	0,46540	0,38194	0,40549	1,00000		
K	0,94011	0,80218	0,85508	0,42428	1,00000	
FDI	-0,01155	-0,09943	0,01976	0,01778	-0,00442	1,00000

Output, labor, materials and other procurement and capital expressed in logarithms.

Appendix 2

Correlation matrix for variables used for estimating the impact of FDI on productivity of domestic plants in an industry

	VL_D	K	LQ	HERF	SCALE	AH	FDI
VL_D	1,00000						
K	0,16240	1,00000					
LQ	0,31942	-0,02699	1,00000				
HERF	0,18823	-0,16600	0,12882	1,00000			
SCALE	0,09543	0,02965	-0,12670	0,01368	1,00000		
AH	-0,07267	-0,07763	0,03884	-0,04344	0,00216	1,00000	
FDI	0,07919	-0,08640	0,23919	-0,03403	-0,52275	0,02007	1,00000

Variables are scaled for convenience.

Appendix 3

Results for estimations of equation 2 with addition of interaction terms (period dummy * FDI), different combinations

Variable	1		2		3		4		5		6	
Constant	1,7191	**	1,9222	**	1,4803	*	1,9222	**	1,8869	**	1,9222	**
	(0,8136)		(0,8140)		(0,8200)		(0,8140)		(0,8162)		(0,8140)	
K	0,2106	***	0,2150	***	0,1984	***	0,2150	***	0,2106	***	0,2150	***
	(0,0382)		(0,0381)		(0,0385)		(0,0381)		(0,0382)		(0,0381)	
LQ	0,1475		0,0838		0,3397		0,0838		0,1543		0,0838	
	(0,2138)		(0,2142)		(0,2122)		(0,2142)		(0,2135)		(0,2142)	
HERF	-0,9310	*	-0,9607	*	-0,9527	*	-0,9607	*	-0,9842	*	-0,9607	*
	(0,5117)		(0,5103)		(0,5162)		(0,5103)		(0,5117)		(0,5103)	
SCALE	1,1526	**	1,1927	**	1,3209	**	1,1927	**	1,2948	**	1,1927	**
	(0,5347)		(0,5333)		(0,5391)		(0,5333)		(0,5337)		(0,5333)	
AH	-0,0161		-0,1220		0,0251		-0,1220		-0,1457		-0,1220	
	(0,4590)		(0,4590)		(0,4637)		(0,4590)		(0,4602)		(0,4590)	
FDI	-0,6226		-0,1775		-0,9797	**	-3,5455	***	-2,5924	***	-1,8274	***
	(0,4124)		(0,4362)		(0,4194)		(0,6001)		(0,5108)		(0,5695)	
FDI75_80	-2,5503	***	-3,3679	***							-1,7181	***
	(0,5041)		(0,5694)								(0,5716)	
FDI81_87			-1,6499	***	-0,1517		1,7181	***				
			(0,5394)		(0,4818)		(0,5716)					
FDI88_94							3,3679	***	2,4216	***	1,6499	**
							(0,5694)		(0,4757)		(0,5394)	
Adjusted R^2	0,75083		0,75225		0,74647		0,7523		0,7509		0,75225	
F-test	46,17	***	46,08	***	45,14	***	46,08	***	46,18	***	46,08	***
Number of industries	78		78		78		78		78		78	
Number of observations	1560		1560		1560		1560		1560		1560	